3.10 VEGETATION

SYNOPSIS

This section describes current conditions and evaluates potential impacts to vegetation from the proposed action and alternatives. Each alternative is examined by major project component: mine site, transportation facilities, and pipeline.

Summary of Existing Conditions:

The EIS Analysis Area primarily lies within four ecoregions: the Kuskokwim Mountains, Tanana-Kuskokwim Lowlands, Alaska Range, and Cook Inlet Basin (Nowacki et al. 2001). A small portion of the project (20.2 acres) lies in a fifth ecoregion, the Yukon-Kuskokwim Delta. Almost two-thirds of the proposed EIS Analysis area is located in the Kuskokwim Mountains ecoregion. All of the mine site and associated road and port sites are contained within this ecoregion, which also covers the westernmost portion (Milepost [MP] 219 to the mine site) of the pipeline. The remaining three ecoregions are the Tanana-Kuskokwim Lowlands, Alaska Range, and Cook Inlet Basin, which are crossed by the pipeline. Three surveys have been conducted to identify and map the vegetation in the EIS Analysis Area, and 45 cover types were identified and grouped into five categories: Deciduous and Mixed Forests; Needleleaf Forests; Shrub; Herbaceous; and Other Land Cover Types. (3PPI 2014a, b).

Invasive Plants: Within the EIS Analysis Area, 26 non-native invasive plant species have been documented during surveys along the Kuskokwim River in the vicinities of Bethel, Kwethluk, Upper and Lower Kalskag, Aniak, Chuathbaluk, Napaimute, Crooked Creek, Georgetown, Red Devil, Sleetmute, Stony River, and Tyonek (Alaska Exotic Plant Information Clearinghouse [AKEPIC] 2015; Carlson and Greenstein 2012). During the wetland delineation and associated vegetation mapping four invasive species were noted (Moody 2013). All were found at a location (Squaw Creek) over 3 miles from the pipeline right-of way (ROW), outside the construction area. During habitat mapping of the pipeline, ARCADIS (2011a) did not identify any species listed on the Alaska State Code Prohibited and Restricted Noxious Weed List (Title 11, Chapter 34, Section 20, 11 AAC 34.020), or any invasive species tracked by Alaska Natural Heritage Program's Alaska (AKNHP) Exotic Plants Information Clearinghouse (AKEPIC). In July 2014, a project-related reconnaissance survey for invasive plants was performed on 160 acres of the mine site and 5 miles of existing roads in or near the Project Area. Eleven invasive plant species were recorded within a total of 123.6 acres (Moody 2015).

Rare and Sensitive Plants: There is only one federally listed rare plant species in Alaska, the Aleutian shield fern, a small fern known to occur only at two locations in the Andreanof Island group of the Aleutian Islands. This species is not documented within nor expected to occur within the Project Area.

AKNHP tracks population information on 318 rare vascular plant species (species of conservation concern) in Alaska (AKNHP 2015a; Nawrocki et al. 2013; Lipkin and Murray 1997). During field work, scientists made several incidental observations of species tracked by AKNHP.

Mine Site: An unconfirmed population of fowl mannagrass (S3G5 - state rare, globally secure) was reported along Anaconda Creek in the mine site during wetland surveys.

Transportation Facilities: No rare plant populations have been documented within the transportation facilities.

Pipeline: Two rare species, bristleleaf sedge (S3G5 - state rare, globally secure) and fragile rockbrake (S3/4G5 - state rare to apparently secure, globally secure), were documented near Farewell Lake, in the Tanana-Kuskokwim Lowlands ecoregion (AKNHP 2015a). During wetland surveys, an additional population of bristleleaf sedge was observed but not confirmed 20 miles southwest of Farewell Lake (Khuchaynik Basin). Populations of two tracked species, little prickly sedge (S1S2G5 - state critically imperiled to imperiled, globally secure) and elephanthead lousewort (S2G5 - state imperiled, globally secure), were documented and confirmed along the pipeline within the Cook Inlet ecoregion (Moody 2013).

Expected Effects:

Alternative 1: No Action – This alternative would not have any new effects on vegetation resources.

Alternative 2: Donlin Gold's Proposed Action - Vegetation in the Project Area would be directly affected by removal and reclamation, and indirectly affected by increased risk of accidental damage, potential introduction or spread of non-native invasive species, fugitive dust and potential environmental contamination, and changes in water availability. Overall effects would be medium in intensity. Duration of effects in some areas, such as the pipeline, would be temporary during the construction phase (construction) only, while in other areas would be long-term during construction and the operations and maintenance phase (operations) (such as roads and airstrips), or permanent such as the pit lake or areas where conditions are changed such that the vegetation will not return to pre-project composition, structure, or function. The geographical extent of impacts would be local, but could become extended if uncontrolled invasive species are introduced or spread from existing populations, or accidental fires spread beyond the proposed Project Area. Context would be common as common vegetation community types would be affected, or important in the case of removal of confirmed occurrences of rare species. The summary impacts of the project on vegetation would be moderate.

Other Alternatives: The effects of other alternatives on vegetation would be similar to the effects of Alternative 2. Differences of note include:

- *Alternative 3A (LNG-Powered Haul Trucks)* – Fewer barge trips would reduce invasion potential by reducing the volume of ocean and river vessel introduction vectors.

- *Alternative 3B (Diesel Pipeline)* – An additional 19 miles of pipeline and clearing in the vicinity of the Tyonek dock would result in an additional 250.7 acres of vegetation removal. The potential for spread of non-native invasive species would be higher than Alternative 2 because of known occurrences of invasive plant species in the vicinity of the Tyonek dock.
- *Alternative 4 (Birch Tree Crossing [BTC] Port)* – The longer mine access road and port facilities would require an additional 732.1 acres of direct vegetation removal. More area would be affected by increased risk of invasive species introduction and spread, fugitive dust, and increased risk environmental contamination. Eliminating barging upstream of BTC would reduce the risk of invasive species introduction in that section of the river.
- *Alternative 5A (Dry Stack Tailings)* – The change in tailings disposal method would directly affect vegetation by increasing the amount of vegetation disturbance at the mine site by 446.8 acres. Dust productive would increase which may impact vegetation.
- *Alternative 6A (Dalzell Gorge Route)* – 1,948.1 less acres of vegetation would be impacted compared to Alternative 2.

3.10.1 REGULATORY FRAMEWORK

The AKNHP maintains data and tracks populations of 318 plant species of conservation concern in Alaska (AKNHP 2015a; Nawrocki et al. 2013; Lipkin and Murray 1997), some of which occur in the Donlin EIS Analysis Area. The AKNHP also tracks non-native invasive plant species in the region through its AKEPIC database, some of which occur within the Project Area. State practices guide invasive species prevention measures on lands managed by the state. BLM policy and practices guide management of invasive species on lands managed by the BLM. There is only one federally listed plant species in Alaska listed under the ESA (Aleutian shield fern [*Polystichum aleuticum*], a small fern known to occur only at two locations in the Aleutians), and it is not known or expected to occur in the Project Area.

3.10.2 AFFECTED ENVIRONMENT

The affected environment for vegetation includes vegetation that may be directly or indirectly affected by the project. The vegetation will be described in terms of ecoregions, vegetation communities, invasive plants, and rare and sensitive plants. The areas of potential effects include the entire Project Area as well as local-to-extended pathways for invasive plant introduction, spread, dispersal, and establishment. Vectors include wind, water, wildlife, humans, and all modes of transportation – aviation, boat, barge, vehicles, off-highway vehicles, heavy equipment, etc. Areas with disturbed or open soil surfaces are especially vulnerable to invasive species infestation.

The Project Area is divided into three components: mine site (pit, tailings storage facility [TSF)] waste rock facility [WRF], camp, and power plant); transportation facilities (barge landing sites and route [Kuskokwim Bay, Kuskokwim River], fuel site in Dutch Harbor, Bethel fuel

storage/port site, Angyaruaq [Jungjuk] or BTC port sites, mine access road, airstrip, and material sources); and pipeline (route, terminal facilities, construction access and camps, airstrips, and material sources).

The following sections describe EIS Analysis Area ecoregions, surveys that were conducted to identify and map the existing vegetation, and the survey results for each project component. Figure 3.10-1 shows the affected areas. The area covered by the wetland/vegetation survey included the mine site, potential port locations and their associated mine access roads (BTC and Angyaruaq [Jungjuk]), and the pipeline.

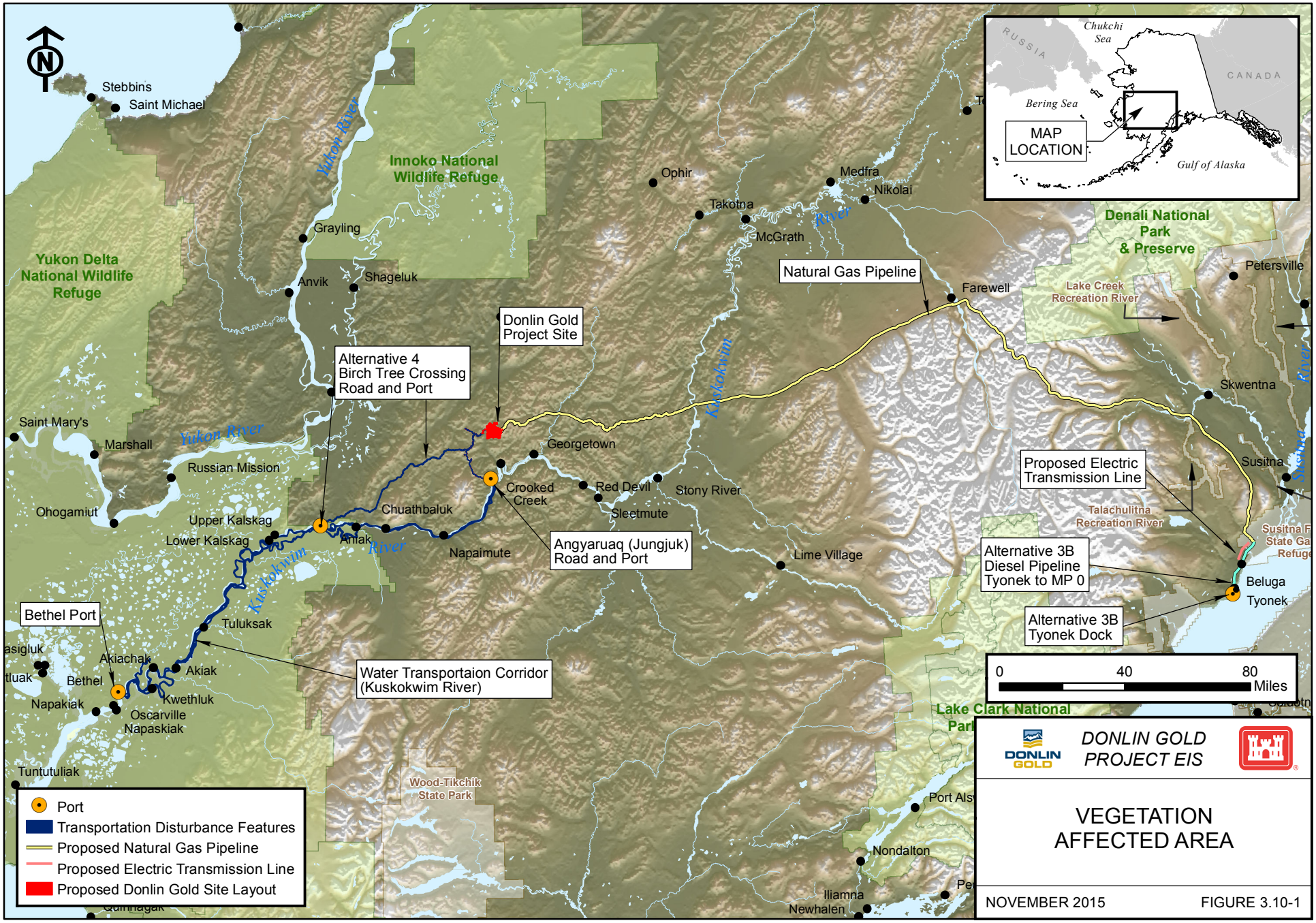
3.10.2.1 ECOREGIONS

The EIS Analysis Area primarily lies within four ecoregions: the Kuskokwim Mountains, Tanana-Kuskokwim Lowlands, Alaska Range, and Cook Inlet Basin (Nowacki et al. 2001) (Figure 3.10-2). A small portion of the project (20.2 acres) lies in a fifth ecoregion, the Yukon-Kuskokwim Delta. This area is located in the Kuskokwim Mountains north of the Kuskokwim River and, for simplicity, will be treated and addressed with the adjacent Kuskokwim Mountains ecoregion in discussion and tables.

Almost two-thirds of the EIS Analysis Area is located in the Kuskokwim Mountains ecoregion. All of the mine site and associated road and port sites are contained within this ecoregion. This ecoregion also covers the westernmost portion (MP 219 to the mine site) of the pipeline route. The remaining three ecoregions – Tanana-Kuskokwim Lowlands, Alaska Range and Cook Inlet Basin – are crossed by the pipeline route.

The Cook Inlet Basin ecoregion lies at the project's eastern boundary. From the eastern terminus of the Project Area, the pipeline route traverses several miles of lowland string bogs as it extends north and west. Then the pipeline route passes through upslope areas dominated by drier forests interspersed with tall shrubs (primarily alder [*Alnus* spp.]). Closed and open forest stands of broadleaf species or mixes of broadleaf and needleleaf species account for over half of the total proposed Project Area (60.7 percent) within the Cook Inlet Basin ecoregion.

The Alaska Range ecoregion is comprised of the Alaska Range Mountains. A cold continental climate predominates in the ecoregion and the mountains are tall, steep, with highest areas generally barren of vegetation. The ecoregion is dominated by low shrubs and alpine scree; forests are generally limited to lower elevation footslopes and riverine valleys (Nowacki et al. 2001). Forests, interspersed with low shrub bogs and patches of dense alders, dominate the EIS Analysis Area between the western border of the Cook Inlet Basin ecoregion and the Lower Happy River watershed. Shrublands transition to forests near Puntilla Lake (Squaw Creek watershed). Shrublands dominate where the pipeline corridor crosses over the Teocalli Mountains at elevations over 2,000 feet. The pipeline corridor traverses the lower elevation open forests of the South Fork of the Tatina River and Kuskokwim River basins. The pipeline route intersects the western border of the 2010 Turquoise Lake burn, near the junction of the Post River and the South Fork of the Kuskokwim River. Four thousand and sixty-one acres of the Turquoise Lake burn occur in the EIS Analysis Area. Photointerpretation of pre-burn imagery indicates that much of the area was previously spruce forest.



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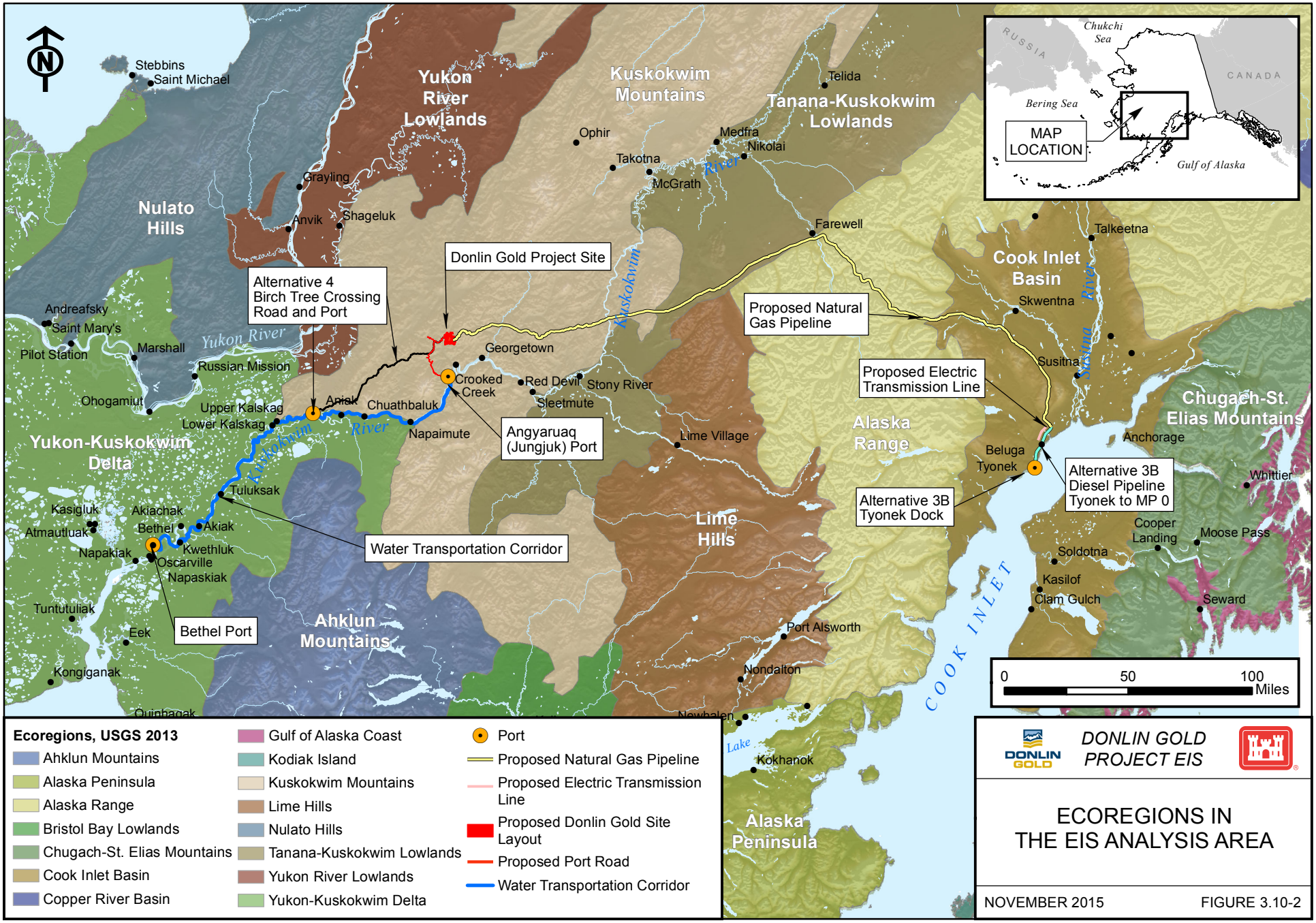
VEGETATION AFFECTED AREA

NOVEMBER 2015 FIGURE 3.10-1


Stebbins
Saint Michael
Yukon River Lowlands
Kuskokwim Mountains
Tanana-Kuskokwim Lowlands
Telida
Ophir
Medfra
Nikolai
Takotna
McGrath
Grayling
Nulato Hills
Anvik
Shageluk
Farewell
Talkeetna
Cook Inlet Basin
Donlin Gold Project Site
Alternative 4 Birch Tree Crossing Road and Port
Kuskokwim River
Proposed Natural Gas Pipeline
Skwentna
Susitna River
Andreafsky
Saint Mary's
Pilot Station
Marshall
Yukon River
Russian Mission
Georgetown
Crooked Creek
Red Devil
Stony River
Sleetmute
Proposed Electric Transmission Line
Susitna
Ohogamiut
Upper Kalskag
Lower Kalskag
Aniak
Chuathbaluk
Napaimute
Angyaruaq (Jungjuk) Port
Lime Village
Alaska Range
Chugach-St. Elias Mountains
Anchorage
Yukon-Kuskokwim Delta
Kuskokwim River
Beluga
Tyonek
Alternative 3B Diesel Pipeline Tyonek to MP 0
Whittier
Tuluksak
Kasigluk
Akiachak
Atmautluak
Bethel
Akiak
Napakiak
Kwethluk
Oscarville
Napaskiak
Alternative 3B Tyonek Dock
Lime Hills
Cooper Landing
Moose Pass
Soldotna
Water Transportation Corridor
Kasilof
Clam Gulch
Seward
Tuntutuliak
Eek
Bethel Port
Ahklun Mountains
Port Alsworth
COOK INLET
Kongiganak
Nondalton
Quinhagak
Lake
Kokhanok
Alaska Peninsula
0
50
100
Miles
MAP LOCATION
Chukchi Sea
RUSSIA
CANADA
Bering Sea
Gulf of Alaska
Ecoregions, USGS 2013
Ahklun Mountains
Alaska Peninsula
Alaska Range
Bristol Bay Lowlands
Chugach-St. Elias Mountains
Cook Inlet Basin
Copper River Basin
Gulf of Alaska Coast
Kodiak Island
Kuskokwim Mountains
Lime Hills
Nulato Hills
Tanana-Kuskokwim Lowlands
Yukon River Lowlands
Yukon-Kuskokwim Delta
Port
Proposed Natural Gas Pipeline
Proposed Electric Transmission Line
Proposed Donlin Gold Site Layout
Proposed Port Road
Water Transportation Corridor
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ECOREGIONS IN THE EIS ANALYSIS AREA
NOVEMBER 2015
FIGURE 3.10-2

The Tanana-Kuskokwim Lowlands alluvial plain falls in the rain-shadow of the Alaska Range and has a dry, Interior Alaska continental climate. Permafrost is thin and discontinuous and creates local conditions of poor soil drainage. Collapsing permafrost creates bogs and fens comprised of ericaceous shrubs (heath family) and sedges. Boreal forests dominate the landscape. Black spruce (*Picea mariana*) is found throughout the poorly drained flats. White spruce (*Picea glauca*), paper birch (*Betula papyrifera*), and quaking aspen (*Populus tremuloides*) occur along the drier river banks and steep, drier south-facing hills. Alder and willow (*Salix* spp.) shrubs are found in small drainages and elsewhere. The pipeline corridor crosses the southern border of the Tanana-Kuskokwim Lowlands ecoregion along the northwest-facing toe slope of the Alaska Range Mountains.

3.10.2.2 SURVEYS

Three surveys have been conducted to identify and map the vegetation in the Project Area. In 2004-2005, Management and Solutions in Environmental Science (MSES) mapped approximately 60,887 acres of vegetation and wildlife habitat using field information and satellite imagery for the mine site, the Angyaruaq (Jungjuk) Port site, and mine access road (MSES 2006).

In 2010, ARCADIS mapped approximately 1,000,000 acres of habitat along the 315-mile long proposed natural gas pipeline corridor using satellite imagery with representative on-the-ground verification (ARCADIS 2011a). The study area consisted of 5 km on either side of the pipeline and extended from approximately sea level near Cook Inlet over Rainy Pass, at an elevation of approximately 3,000 feet, then across tributaries of the Kuskokwim River to the mine site. The supervised (verification component) vegetation classification survey was conducted in the height of the growing season, during the first two weeks of July 2010, to ensure the highest probability of plant identification. Additional surveys were conducted in August of 2010 to complete work that was delayed due to unfavorable weather conditions. Prior to conducting the field survey, an unsupervised landcover classification was produced using satellite Landsat™ imagery.

Between 1996 through 2014, Three Parameters Plus, Inc. (3PPI) mapped approximately 331,882 acres of vegetation and wetlands across the entire EIS Analysis Area and prepared a Preliminary Jurisdictional Wetland Determination (PJD) (3PPI 2014b).

Forty-five cover types are recognized in the EIS Analysis Area (3PPI 2014a). Twenty-four cover types are distributed throughout the EIS Analysis Area. Twelve cover types are distributed only in the pipeline, and nine cover types are in areas west of the pipeline.

The 45 cover types are grouped into 5 categories: Deciduous and Mixed Forests; Needleleaf Forests; Shrub; Herbaceous; and Other Land Cover Types (unvegetated or partially vegetated). The distribution of these cover types within the EIS Analysis Area is described by project component.

3.10.2.3 MINE SITE

The vegetation types mapped in the mine site area are listed and described in Table 3.10-1 and shown in Figure 3.10-3. The descriptions are abbreviated versions of complete descriptions found in 3PPI's PJD (3PPI 2014b).

Table 3.10-1: Vegetation Types in the Mine Site Area

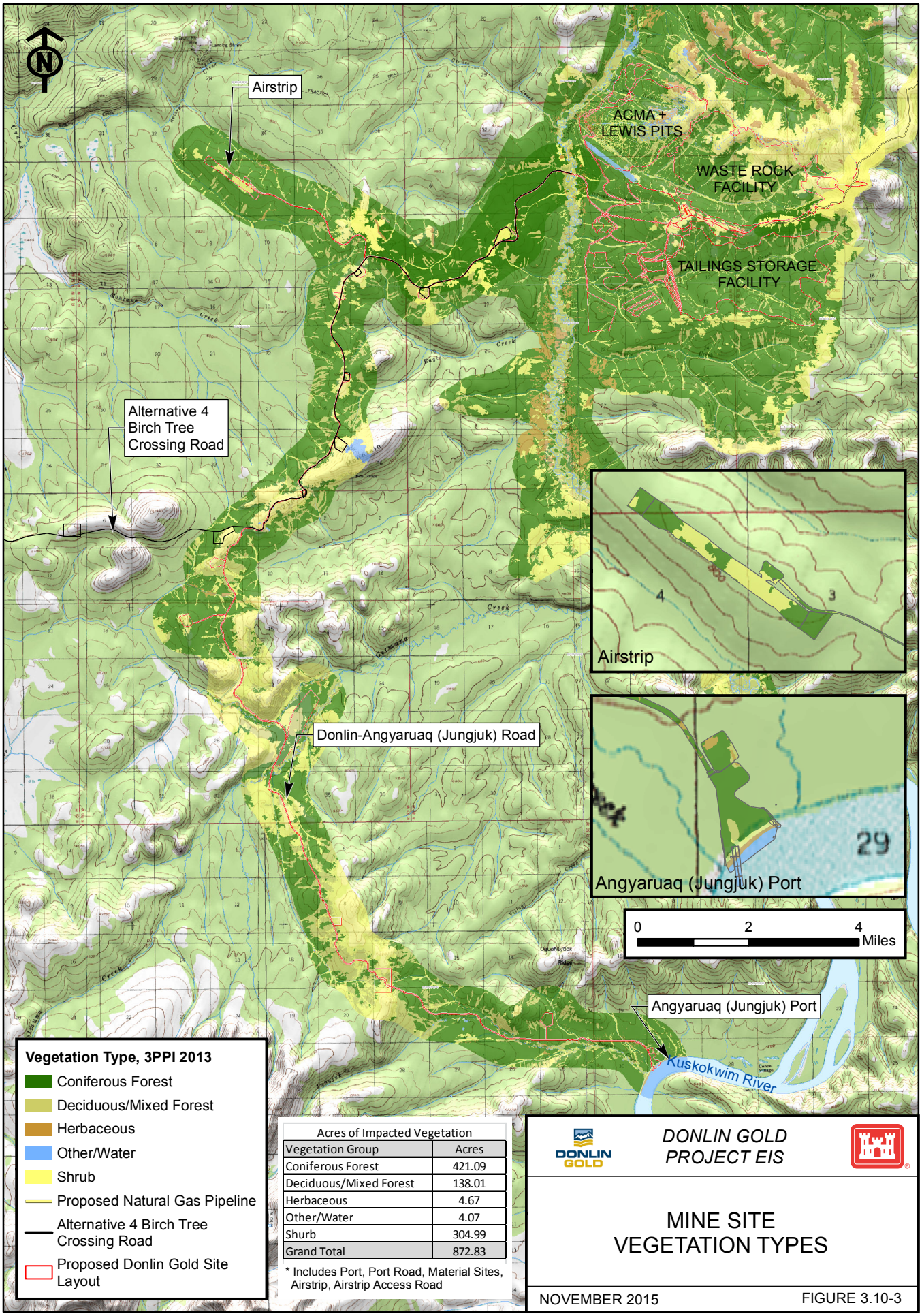
Vegetation Type	Description	Subtypes	Area Mapped (Acres)	Percentage of Mapped Area
Forested – Deciduous/Mixed	Tree/sapling cover greater than 10%	Closed forest, open forest, woodland forest, mixed forest, alluvial-terrace	4,299.0	9.4%
Forested - Coniferous	Tree/sapling cover greater than 10%	Closed and open black spruce, closed and open white spruce, spruce woodland moss lichen	25,856.2	63.9%
Shrub	Shrub cover greater than 25%	Closed shrub, open shrub, tall shrub, low shrub, dwarf shrub, alder, willow, ericaceous bog	7,809.2	19.3%
Herbaceous	Lack of woody plants or less than 10 percent cover in tree species and less than 25 percent cover in shrubs.	Grass, sedge, emergent, aquatic, blue, joint tall grass, lichen mat, tussock sedge, aquatic herbaceous, mesic herbaceous	1,871.6	4.6%
Other Land Cover	Less than 25% ground cover, vegetation cover less than 10%.	Partially vegetated, bare ground, talus, gravel bars, fill, open water, snow.	655.6	1.6%

Source: 3PPI 2014b.

Spruce-dominated coniferous forests cover large portions of the mine site area. On north-facing slopes and other areas where drainage is restricted by the presence of permafrost, stunted black spruce forests predominate. Black spruce forests also extend into bottomlands and other wet areas. In better drained sites such as those on floodplain terraces, near timberline, and on warmer south-facing slopes, white spruce forests are more prevalent. Mixed coniferous / deciduous forests are also common on drier slopes and consist of white spruce and paper birch. These mixed wood forest communities are also found on floodplain terraces and may include balsam poplar (*Populus balsamifera*).

River meanders, such as those along Crooked Creek, support a continuous succession of early successional willow and alder, followed by balsam poplar, which is replaced by spruce. Recently disturbed sites, areas near timberline, north-facing slopes, and wetter areas support scrub communities dominated by willow, alder, and dwarf and shrub birch (*Betula nana* and *B. glandulosa*). Bottomland bogs and other extremely wet areas are occupied by scrub communities, including willow, dwarf birch, bog blueberry (*Vaccinium uliginosum*), Labrador-tea (*Ledum palustre* spp. *decumbens*), shrubby cinquefoil (*Dasiphora fruticosa*), cottongrasses (*Eriophorum* spp.), and sedges (*Carex* spp.).

At higher elevations above timberline, dwarf alpine shrub communities are common and are dominated by ericaceous (heath family) shrubs, dryas (*Dryas* spp.), and dwarf birch. These communities often have considerable lichen cover and some patches of bare ground.



Acres of Impacted Vegetation

Vegetation Group	Acres
Coniferous Forest	421.09
Deciduous/Mixed Forest	138.01
Herbaceous	4.67
Other/Water	4.07
Shurb	304.99
Grand Total	872.83

* Includes Port, Port Road, Material Sites, Airstrip, Airstrip Access Road

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MINE SITE VEGETATION TYPES

NOVEMBER 2015

FIGURE 3.10-3

3.10.2.4 TRANSPORTATION FACILITIES

The vegetation types mapped in the transportation facilities area under Alternative 2, (including the Angyaruaq [Jungjuk] Port site and mine access road, material sites along the road, and airstrip) are listed and described in Table 3.10-2 and shown on Figure 3.10-4. The vegetation for other alternatives would be the same as for Alternative 2, except for Alternative 4, which has varying percent composition including more shrub type percent and less coniferous forest percent (Table 3.10-3).

Table 3.10-2: Vegetation Types in the Transportation Facilities Area, Alternative 2

Vegetation Type	Description	Subtypes	Area Mapped (Acres)	Percentage of Mapped Area
Forested – Deciduous/Mixed	Tree/sapling cover greater than 10%	Closed forest, open forest, woodland forest, mixed forest, alluvial forests	3,198.9	14.0%
Forested - Coniferous	Tree/sapling cover greater than 10%	Closed (mixed) spruce forest, open black spruce forests, spruce woodland with lichen, moss, and shrub understory	14,062.4	61.3%
Shrub	Shrub cover greater than 25%	Closed shrub, open shrub, tall shrub, low shrub, dwarf shrub	5,035.0	22.0%
Herbaceous	Herbaceous communities lack woody plants or have less than 10 percent cover in tree species and less than 25 percent cover in shrubs.	Grass, sedge, emergent, aquatic	187.8	0.8%
Other Land Cover	Less than 25% ground cover, vegetation cover less than 10%.	Bare ground, open water, partially vegetated.	436.6	1.9%

Source: 3PPI 2014b.

Table 3.10-3: Vegetation Types in the Transportation Facilities Area, Alternative 4

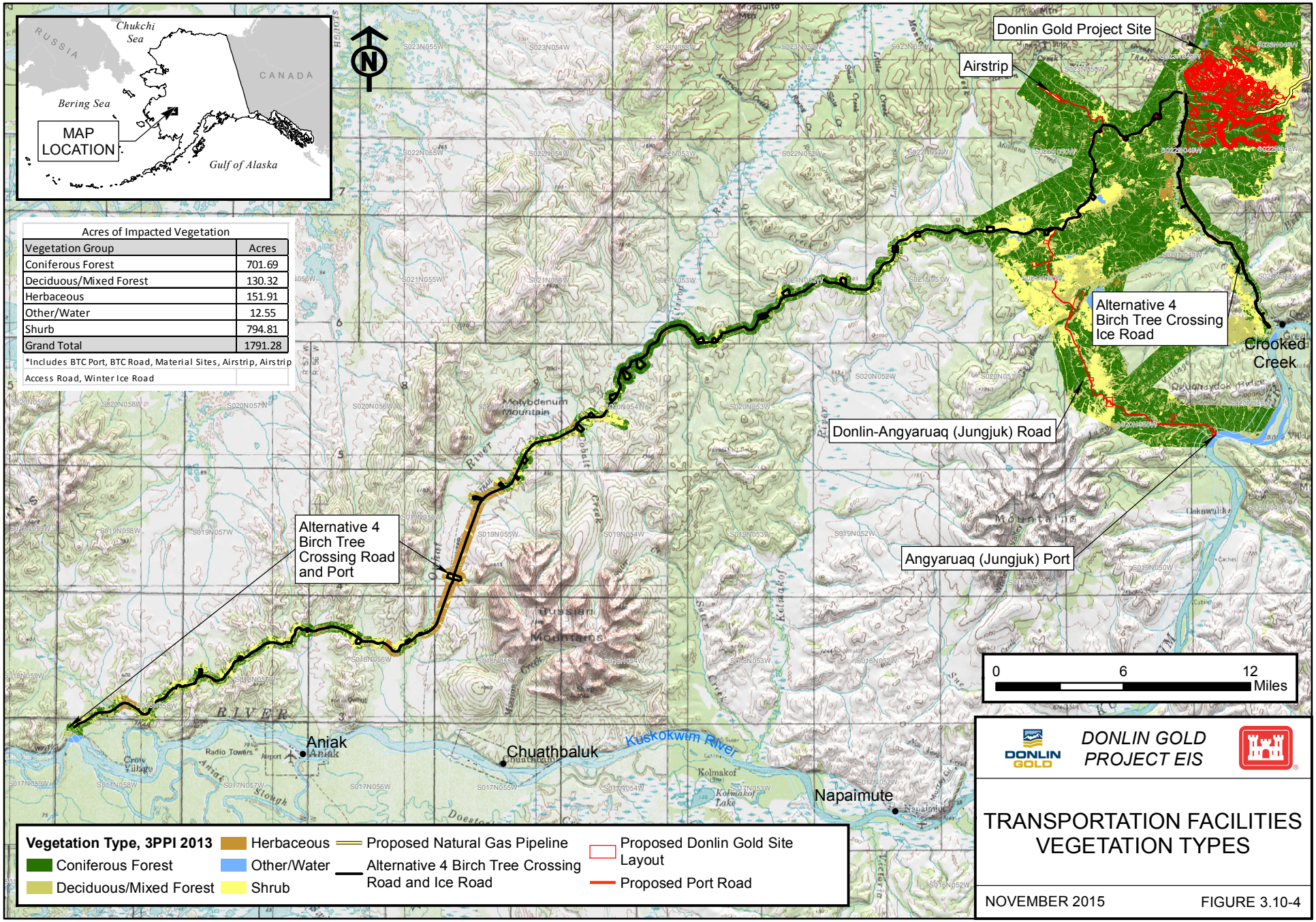
Vegetation Type	Description	Subtypes	Area Mapped (Acres)	Percentage of Mapped Area
Forested – Deciduous/Mixed	Tree/sapling cover greater than 10%	Closed forest, open forest, woodland forest, mixed forest, alluvial forests	1,130.3	7.3%
Forested - Coniferous	Tree/sapling cover greater than 10%	Closed (mixed) spruce forest, open black spruce forests, spruce woodland with lichen, moss, and shrub understory	701.7	39.2%
Shrub	Shrub cover greater than 25%	Closed shrub, open shrub, tall shrub, low shrub, dwarf shrub	794.8	44.4%
Herbaceous	Herbaceous communities lack woody plants or have less than 10 percent cover in tree species and less than 25 percent cover in shrubs.	Grass, sedge, emergent, aquatic	151.9	8.5%
Other Land Cover	Less than 25% ground cover, vegetation cover less than 10%.	Bare ground, open water, partially vegetated.	12.5	0.7%

Source: 3PPI 2014b.

3.10.2.5 PIPELINE

The vegetation types mapped in the pipeline area (including the 150-foot wide pipeline ROW, footprints of facilities, access roads, airstrips, material sites, and other pipeline features), are listed and described in Table 3.10-4 and shown on Figure 3.10-5A through Figure 3.10-5G. The pipeline corridor is separated into two distinct regions, east and west of the Alaska Range ecoregion. The eastern portion of the pipeline, located within the Cook Inlet ecoregion, is generally characterized by mixed forest along the larger rivers of the region (i.e., the Susitna, Skwentna, Happy, and Hayes rivers and their tributaries). The portion of the pipeline corridor west of the Alaska Range runs through the Kuskokwim Mountains and Kuskokwim lowlands ecoregions, and is largely black spruce forest in low-lying tundra habitat commonly associated with the larger Kuskokwim and Yukon rivers (ARCADIS 2011a).

A general description of how these vegetation types are distributed within the pipeline area follows.



Acres of Impacted Vegetation

Vegetation Group	Acres
Coniferous Forest	701.69
Deciduous/Mixed Forest	130.32
Herbaceous	151.91
Other/Water	12.55
Shrub	794.81
Grand Total	1791.28

*Includes BTC Port, BTC Road, Material Sites, Airstrip, Airstrip Access Road, Winter Ice Road

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TRANSPORTATION FACILITIES VEGETATION TYPES

NOVEMBER 2015 FIGURE 3.10-4

Table 3.10-4: Vegetation Types in the Pipeline Area

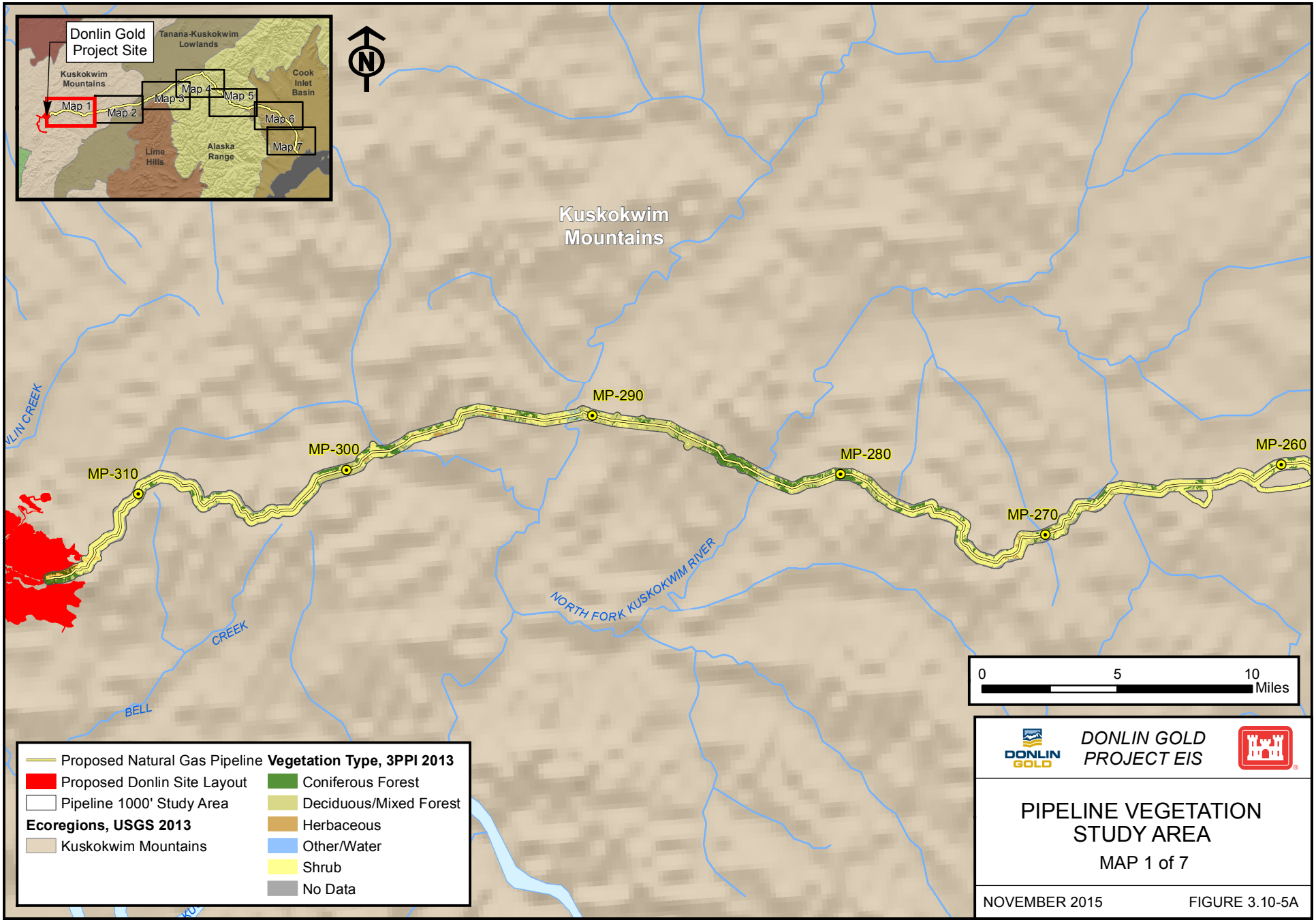
Vegetation Type	Description	Subtypes	Area Mapped (Acres)	Percentage of Mapped Area
Deciduous and Mixed Forest	Tree/sapling cover greater than 10%	Closed forest, open forest, woodland forest, mixed forest	25,028.4	26.2%
Coniferous Forest	Tree/sapling cover greater than 10%	Closed (mixed) spruce forest, open black spruce forests, spruce woodland with lichen, moss, and shrub understory	24,440.4	25.2%
Shrub	Less than 25% ground cover, vegetation cover less than 10%.	Closed shrub, open shrub, tall shrub, low shrub, dwarf shrub	39,297.7	41.1%
Herbaceous	Herbaceous communities lack woody plants or have less than 10 percent cover in tree species and less than 25 percent cover in shrubs.	Grass, sedge, emergent, aquatic	3,757.8	3.9%
Other Land Cover	Less than 25% ground cover	Partially vegetated, unvegetated	3,158.2	3.3%

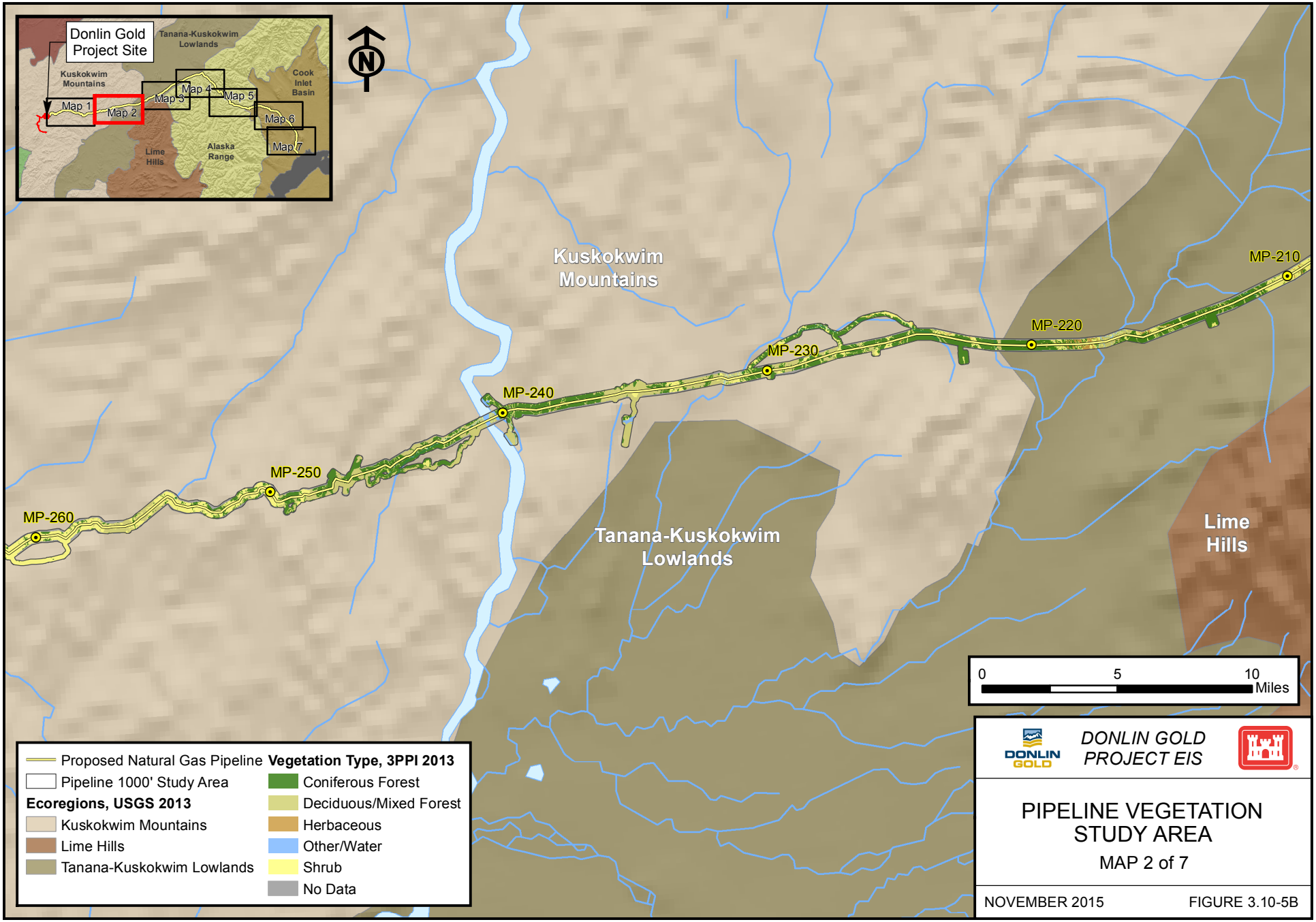
Source: 3PPI 2014b.

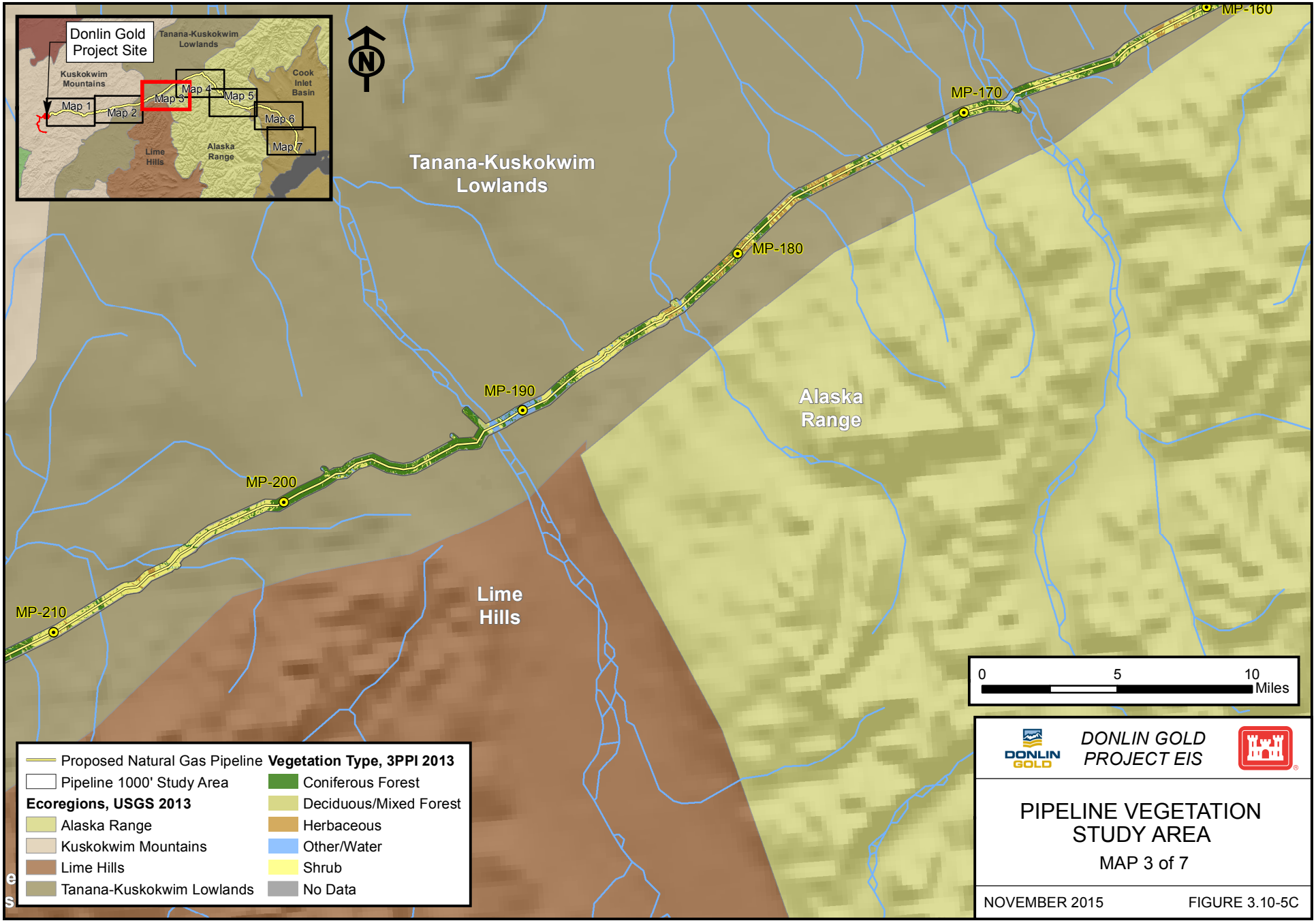
3.10.2.6 INVASIVE PLANTS

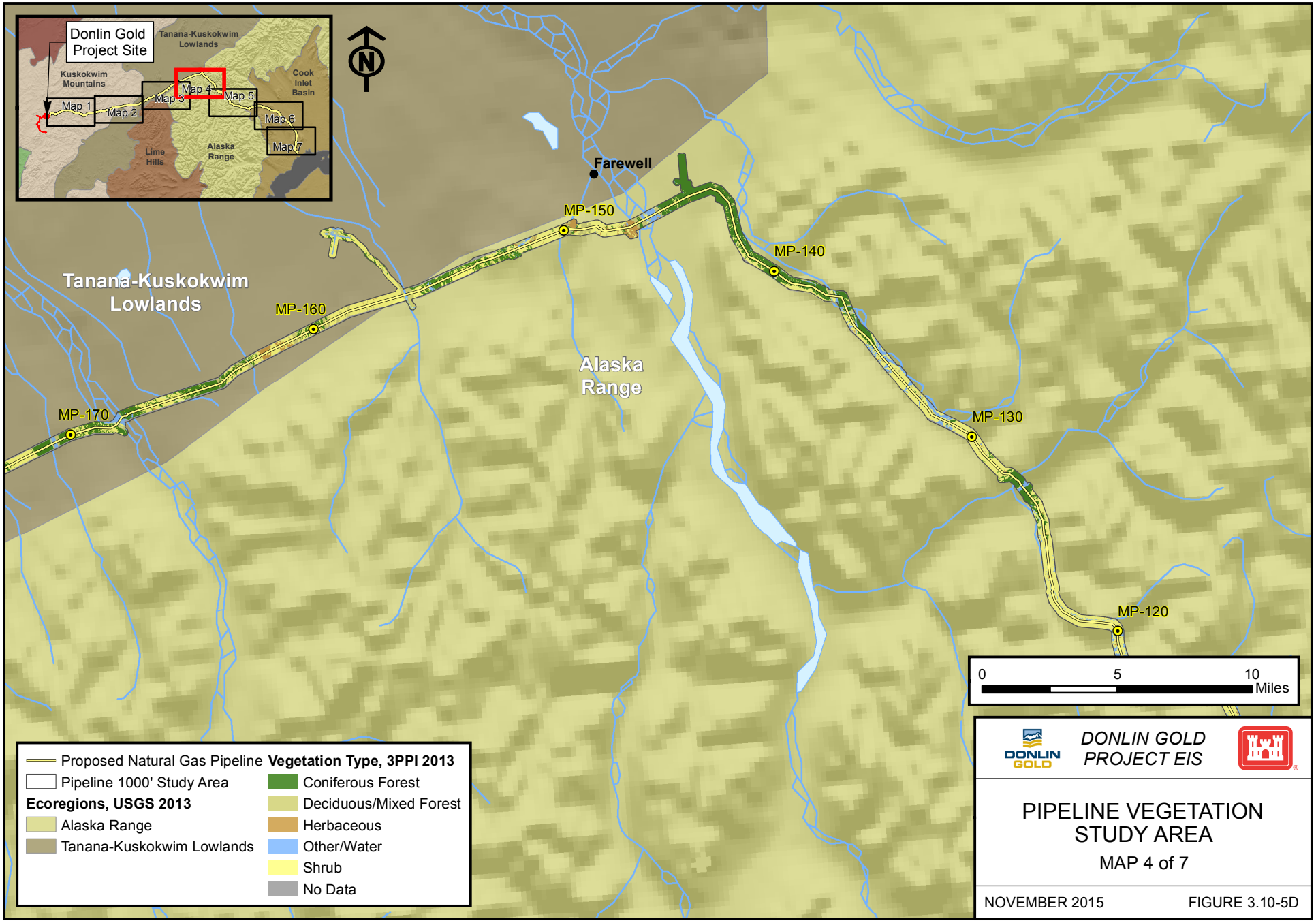
AKNHP maintains data and tracks populations of non-native invasive plant species found in Alaska and determines an invasiveness ranking for species. Ranking is a score between 0 and 100 based on ecological impacts, biological characteristics and dispersal ability, distribution, and feasibility of control. Scores greater than 80 indicate the species is Extremely Invasive, 70 to 79 are Highly Invasive, both very threatening to Alaska; scores of 60 to 69 are Moderately Invasive, while 50 to 59 are Modestly Invasive, both posing substantial risks to ecosystems in Alaska; scores of 40 to 49 are Weakly Invasive, and scores less than 40 are considered Very Weakly Invasive, and probably do not require as much attention as other species (Nawrocki et al. 2011; Carlson et al. 2008). All invasive species observed (26 total within the EIS Analysis Area), their invasiveness ranking, and general location are listed in Table 3.10-5.

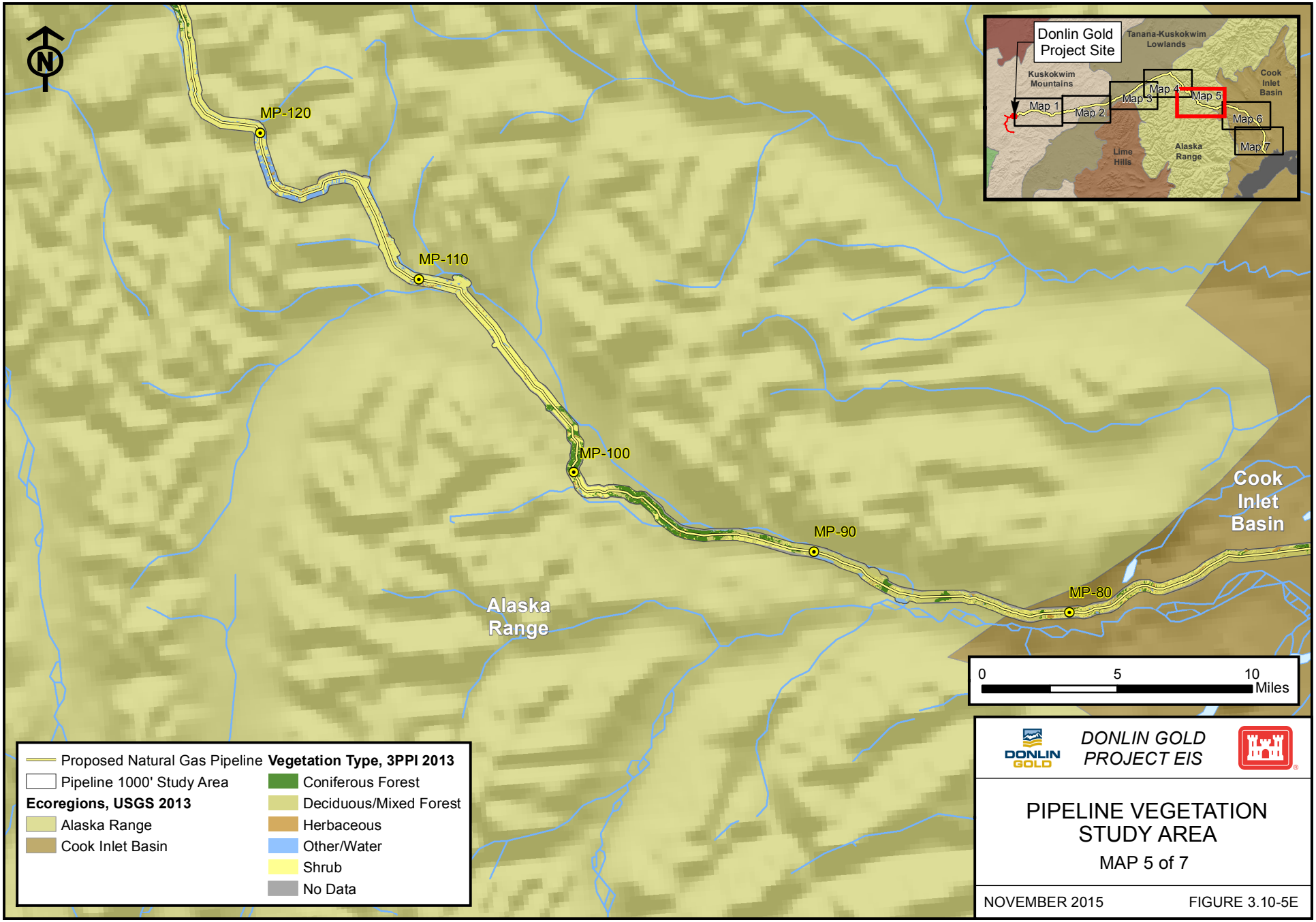
Within the mine site, 12 invasive plant species have been recorded, all Moderately Invasive or less. In July 2014 a project-related reconnaissance survey for invasive plant species covered 160 acres of the mine site and 5 miles of existing roads in or near the Project Area. Eleven invasive plant species were calculated to occupy a total of 123.6 acres, including three species (Icelandic poppy [*Papaver nudicaule*], Kentucky bluegrass [*Poa pratensis* spp. *pratensis*], and alsike clover [*Trifolium hybridum*]) known from Alaska but previously unrecorded within the Project Area (Moody 2015). Mine site invasive plant locations are illustrated on Figure 3.10-6.

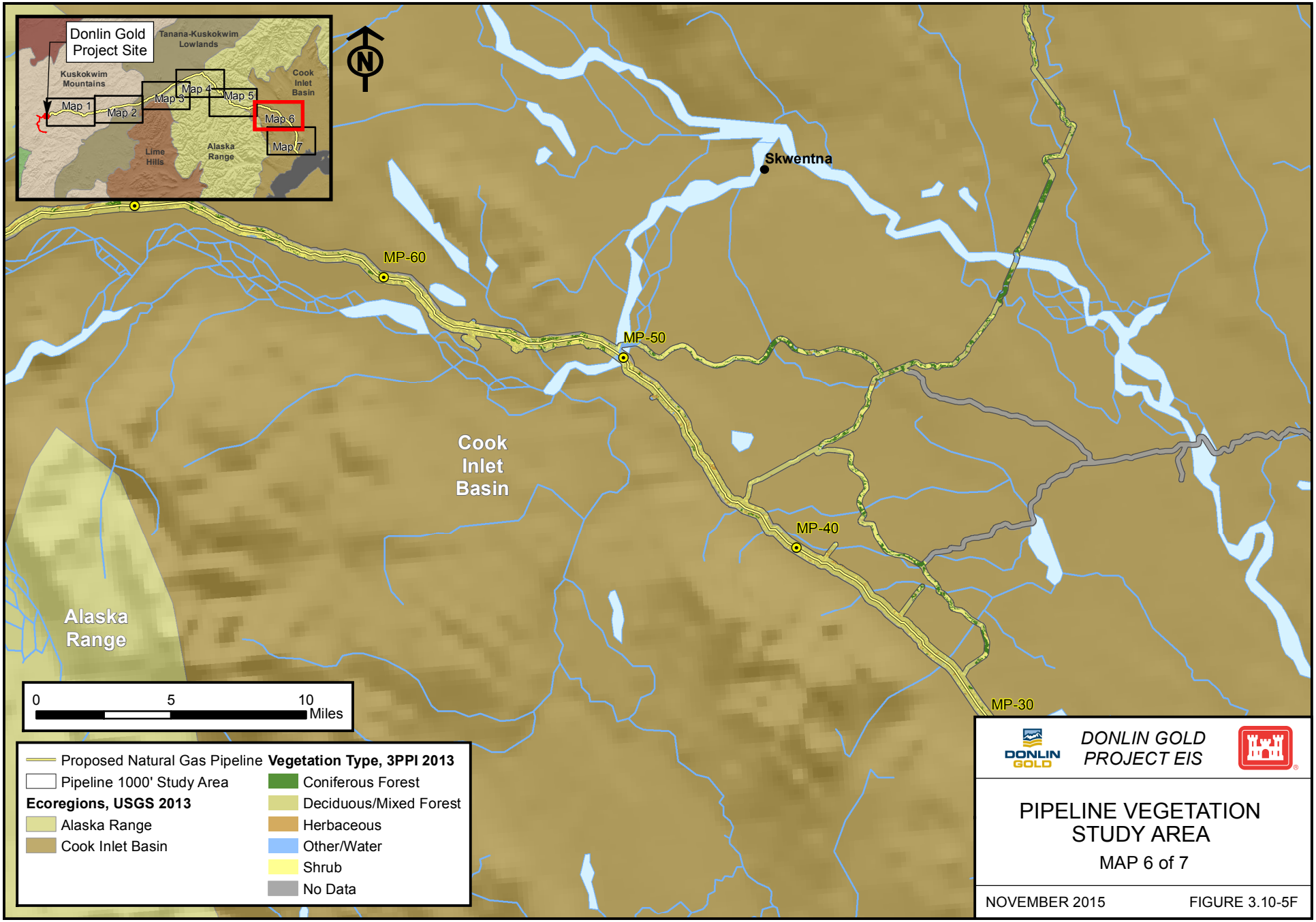

Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Lime Hills
Alaska Range
N
Kuskokwim Mountains
MP-310
MP-300
MP-290
MP-280
MP-270
MP-260
NORTH FORK KUSKOKWIM RIVER
BELL
CREEK
0
5
10
Miles
Proposed Natural Gas Pipeline
Proposed Donlin Site Layout
Pipeline 1000' Study Area
Ecoregions, USGS 2013
Kuskokwim Mountains
Vegetation Type, 3PPI 2013
Coniferous Forest
Deciduous/Mixed Forest
Herbaceous
Other/Water
Shrub
No Data
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 1 of 7
NOVEMBER 2015
FIGURE 3.10-5A

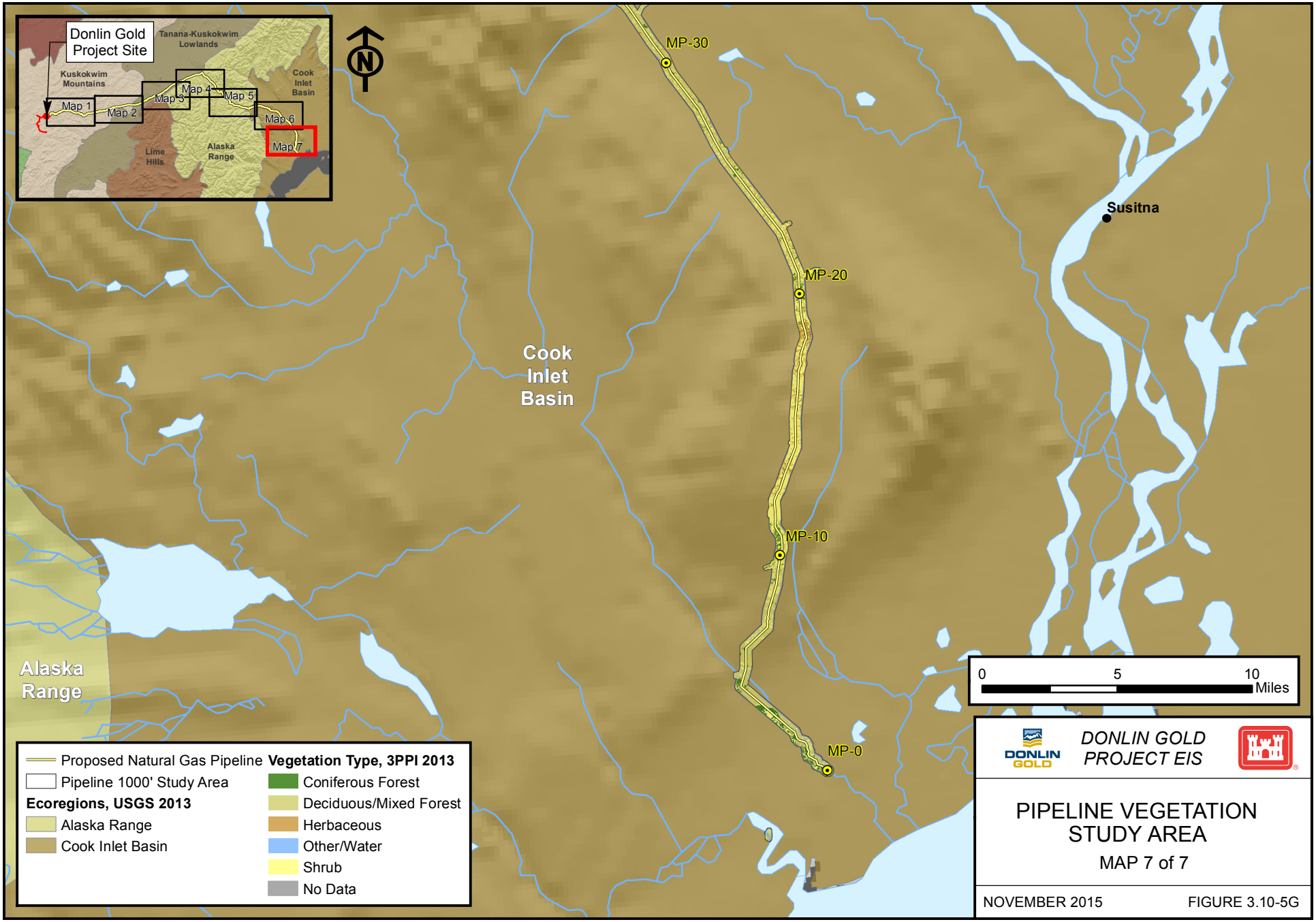

Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
N
Kuskokwim Mountains
Tanana-Kuskokwim Lowlands
Lime Hills
MP-210
MP-220
MP-230
MP-240
MP-250
MP-260
0
5
10
Miles
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregions, USGS 2013
Kuskokwim Mountains
Lime Hills
Tanana-Kuskokwim Lowlands
Vegetation Type, 3PPI 2013
Coniferous Forest
Deciduous/Mixed Forest
Herbaceous
Other/Water
Shrub
No Data
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 2 of 7
NOVEMBER 2015
FIGURE 3.10-5B


Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
N
MP-160
MP-170
MP-180
MP-190
MP-200
MP-210
Tanana-Kuskokwim Lowlands
Alaska Range
Lime Hills
0
5
10
Miles
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregions, USGS 2013
Alaska Range
Kuskokwim Mountains
Lime Hills
Tanana-Kuskokwim Lowlands
Vegetation Type, 3PPI 2013
Coniferous Forest
Deciduous/Mixed Forest
Herbaceous
Other/Water
Shrub
No Data
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 3 of 7
NOVEMBER 2015
FIGURE 3.10-5C


Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
N
Farewell
MP-150
MP-140
MP-160
MP-170
MP-130
MP-120
Tanana-Kuskokwim Lowlands
Alaska Range
0
5
10
Miles
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregions, USGS 2013
Alaska Range
Tanana-Kuskokwim Lowlands
Vegetation Type, 3PPI 2013
Coniferous Forest
Deciduous/Mixed Forest
Herbaceous
Other/Water
Shrub
No Data
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 4 of 7
NOVEMBER 2015
FIGURE 3.10-5D

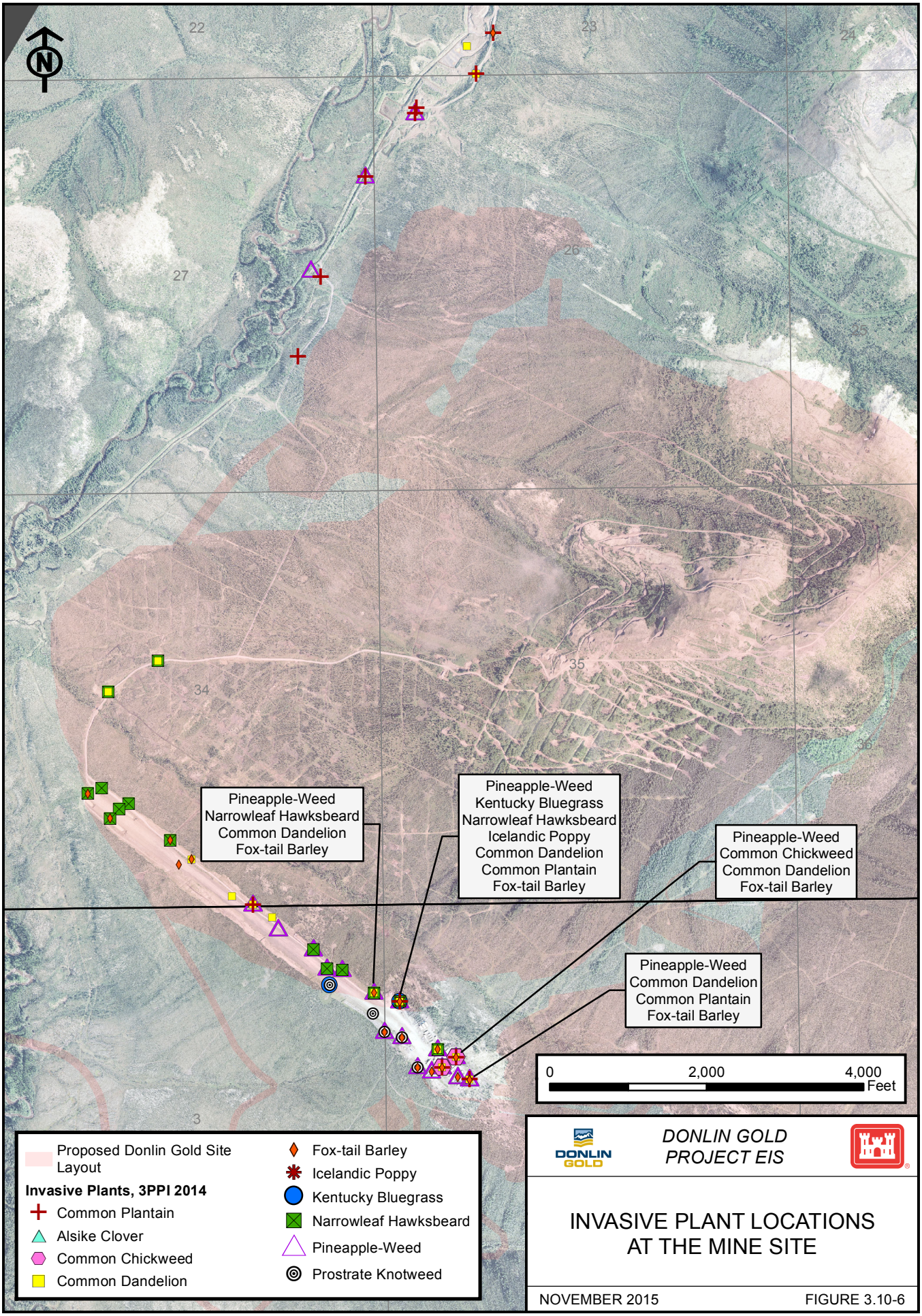

Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
MP-120
MP-110
MP-100
MP-90
MP-80
Alaska Range
Cook Inlet Basin
0
5
10
Miles
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregions, USGS 2013
Alaska Range
Cook Inlet Basin
Vegetation Type, 3PPI 2013
Coniferous Forest
Deciduous/Mixed Forest
Herbaceous
Other/Water
Shrub
No Data
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 5 of 7
NOVEMBER 2015
FIGURE 3.10-5E


Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
N
Skwentna
MP-60
MP-50
MP-40
MP-30
Cook Inlet Basin
Alaska Range
0
5
10
Miles
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregions, USGS 2013
Alaska Range
Cook Inlet Basin
Vegetation Type, 3PPI 2013
Coniferous Forest
Deciduous/Mixed Forest
Herbaceous
Other/Water
Shrub
No Data
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 6 of 7
NOVEMBER 2015
FIGURE 3.10-5F


Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
N
MP-30
MP-20
MP-10
MP-0
Susitna
Cook Inlet Basin
Alaska Range
0
5
10
Miles
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregions, USGS 2013
Alaska Range
Cook Inlet Basin
Vegetation Type, 3PPI 2013
Coniferous Forest
Deciduous/Mixed Forest
Herbaceous
Other/Water
Shrub
No Data
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 7 of 7
NOVEMBER 2015
FIGURE 3.10-5G

Within the water transportation corridor (in the transportation facilities component), 21 invasive species have been recorded during surveys along the Kuskokwim River in the vicinities of Bethel, Kwethluk, Upper and Lower Kalskag, Aniak, Chuathbaluk, Napaimute, and Crooked Creek (AKEPIC 2015). Locations are shown on Figure 3.10-7.

Fifteen invasive plant species have been recorded or documented along the pipeline route (in the pipeline component) in surveys in Georgetown, Red Devil, Sleetmute, Stony River, and Tyonek; and along the Iditarod National Historic Trail (AKEPIC 2015; Flagstad and Cortés-Burns 2010). During the wetland delineation and associated vegetation mapping, four invasive plant species were incidentally noted including one previously unrecorded species (annual bluegrass [*Poa annua*]). All four species were found close together at a location (Squaw Creek) over 3 miles from the pipeline, well outside the construction area (Moody 2013). During pipeline habitat mapping no species listed on the ADNR Prohibited and Restricted List (11 AAC 34.020) or any of the invasive species tracked in AKEPIC were noted (ARCADIS 2011a). Pipeline route invasive locations are depicted on Figure 3.10-8.

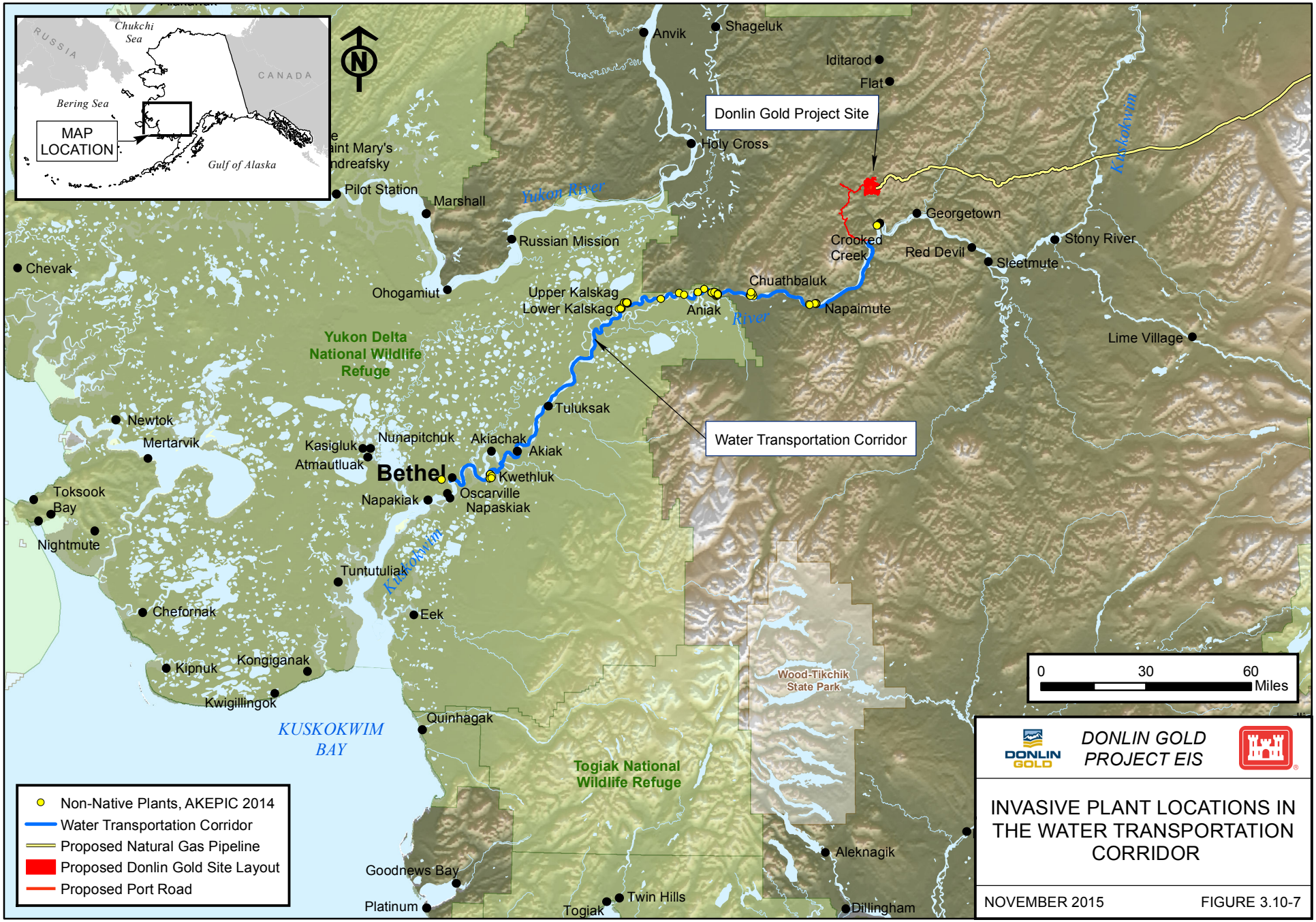


DONLIN GOLD

DONLIN GOLD PROJECT EIS

INVASIVE PLANT LOCATIONS AT THE MINE SITE

NOVEMBER 2015 FIGURE 3.10-6


MAP LOCATION
Chukchi Sea
RUSSIA
CANADA
Bering Sea
Gulf of Alaska
Donlin Gold Project Site
Anvik
Shageluk
Iditarod
Flat
Holy Cross
Pilot Station
Marshall
Yukon River
Russian Mission
Georgetown
Crooked Creek
Red Devil
Sleetmute
Stony River
Kuskokwim
Chevak
Ohogamiut
Upper Kalskag
Lower Kalskag
Aniak
Chuathbaluk
Napaimute
Lime Village
Yukon Delta National Wildlife Refuge
Tuluksak
Water Transportation Corridor
Newtok
Mertarvik
Nunapitchuk
Akiachak
Akiak
Kasigluk
Atmautluak
Bethel
Kwethluk
Oscarville
Napaskiak
Napakiak
Toksook Bay
Nightmute
Tuntutuliak
Eek
Chefornak
Kipnuk
Kongiganak
Kwigillingok
KUSKOKWIM BAY
Quinhagak
Togiak National Wildlife Refuge
Wood-Tikchik State Park
Aleknagik
Goodnews Bay
Platinum
Togiak
Twin Hills
Dillingham
0
30
60
Miles
Non-Native Plants, AKEPIC 2014
Water Transportation Corridor
Proposed Natural Gas Pipeline
Proposed Donlin Gold Site Layout
Proposed Port Road
DONLIN GOLD
DONLIN GOLD PROJECT EIS
INVASIVE PLANT LOCATIONS IN THE WATER TRANSPORTATION CORRIDOR
NOVEMBER 2015
FIGURE 3.10-7

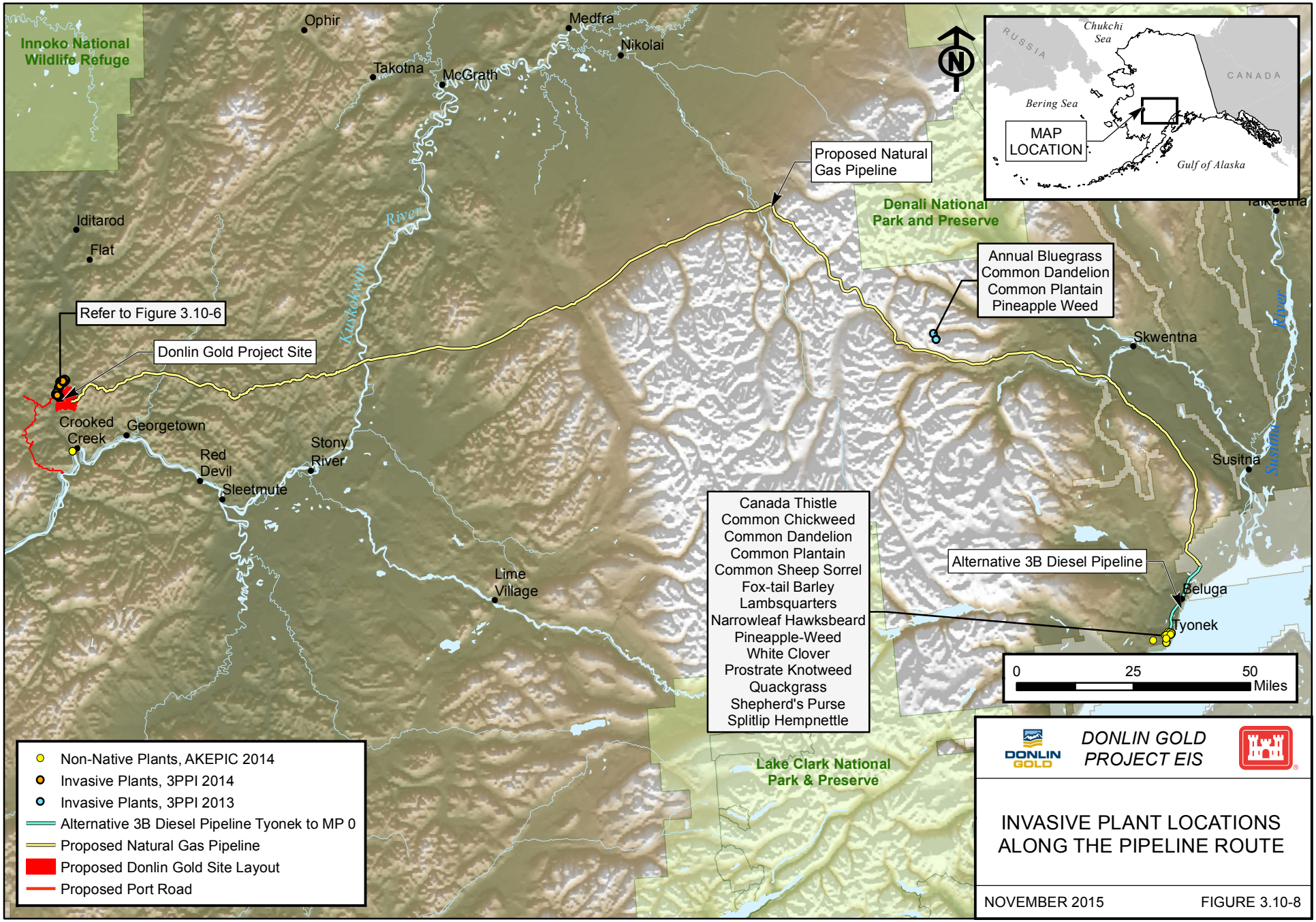

Innoko National Wildlife Refuge
Ophir
Medfra
Nikolai
Takotna
McGrath
Iditarod
Flat
Kuskokwim River
Proposed Natural Gas Pipeline
Denali National Park and Preserve
Annual Bluegrass
Common Dandelion
Common Plantain
Pineapple Weed
Refer to Figure 3.10-6
Donlin Gold Project Site
Skwentna
Susitna River
Crooked Creek
Georgetown
Red Devil
Stony River
Sleetmute
Lime Village
Susitna
Canada Thistle
Common Chickweed
Common Dandelion
Common Plantain
Common Sheep Sorrel
Fox-tail Barley
Lambsquarters
Narrowleaf Hawksbeard
Pineapple-Weed
White Clover
Prostrate Knotweed
Quackgrass
Shepherd's Purse
Splitlip Hempnettle
Alternative 3B Diesel Pipeline
Beluga
Tyonek
Lake Clark National Park & Preserve
N
RUSSIA
Chukchi Sea
CANADA
Bering Sea
MAP LOCATION
Gulf of Alaska
0
25
50
Miles
Non-Native Plants, AKEPIC 2014
Invasive Plants, 3PPI 2014
Invasive Plants, 3PPI 2013
Alternative 3B Diesel Pipeline Tyonek to MP 0
Proposed Natural Gas Pipeline
Proposed Donlin Gold Site Layout
Proposed Port Road
DONLIN GOLD
DONLIN GOLD PROJECT EIS
INVASIVE PLANT LOCATIONS ALONG THE PIPELINE ROUTE
NOVEMBER 2015
FIGURE 3.10-8

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Mine Site (12)	Between Lyman and Donlin Camp (6)	narrowleaf hawksbeard	*Crepis tectorum*	56	3PPI	4,239	91	2	N/A
		foxtail barley	*Hordeum jubatum*	63		2,851	50	7	N/A
		pineappleweed	*Matricaria discoidea*	32		5,090	64	6	N/A
		common plantain	*Plantago major*	44		10,411	69	14	N/A
		Kentucky bluegrass	*Poa pratensis ssp. pratensis*	52		3,138	11	5	N/A
		common dandelion	*Taraxacum officinale*	58		21,964	43	5	N/A
	Donlin Camp/ Airstrip (9)	narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	12	N/A
		foxtail barley	*Hordeum jubatum*	63		2,851	50	16	N/A
		pineappleweed	*Matricaria discoidea*	32		5,090	64	16	N/A
		Icelandic poppy	*Papaver croceum (P. nudicaule)*	39		109	1	1	N/A
		common plantain	*Plantago major*	44		10,411	69	5	N/A
		Kentucky bluegrass	*Poa pratensis ssp. pratensis*	52		3,138	11	2	N/A
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	5	N/A

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Mine Site (12) (continued)	Donlin Camp/ Airstrip (9) (continued)	common chickweed	*Stellaria media*	42		784	19	2	N/A
		common dandelion	*Taraxacum officinale*	58		21,964	43	10	N/A
	Lyman Yard/ Airstrip (8)	foxtail barley	*Hordeum jubatum*	63		2,851	50	10	N/A
		oxeye daisy	*Leucanthemum vulgare*	61		4,010	6	1	N/A
		pineappleweed	*Matricaria discoidea*	32		5,090	64	6	N/A
		common plantain	*Plantago major*	44		10,411	69	11	N/A
		Kentucky bluegrass	*Poa pratensis ssp. pratensis*	52		3,138	11	4	N/A
		common chickweed	*Stellaria media*	42		784	19	1	N/A
		common dandelion	*Taraxacum officinale*	58		21,964	43	10	N/A
		alsike clover	*Trifolium hybridum*	57		5,185	4	4	N/A
		bull thistle	*Cirsium arvense*	76		568	1	1	0.0002
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	2	0.0001
		quackgrass	*Elymus repens*	59		1,146	1	1	2.1
		splitlip hempnettle	*Galeopsis bifida*	50		208	14	4	4.601

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Mine Site (12) (continued)	Lyman Yard/ Airstrip (8) (continued)	pineappleweed	*Matricaria discoidea*	32		5,090	64	7	7.121
		common plantain	*Plantago major*	44		10,411	69	12	0.7
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	3	0.1
		sheep sorrel	*Rumex acetosella*	51		7,440	12	1	2.3
		common chickweed	*Stellaria media*	42		784	19	5	7.201
		common dandelion	*Taraxacum officinale*	58		21,964	43	11	5.2
		foxtail barley	*Hordeum jubatum*	63		2,851	50	6	1
		white clover	*Trifolium repens*	59		8,450	12	9	0.72
Water Transportation Facilities (21)	Aniak (13)	shepherd's purse	*Capsella bursa-pastoris*	40		1,213	7	5	0.1
		Siberian peashrub	*Caragana arborescens*	74		83	2	1	0.5
		big chickweed	*Cerastium fontanum spp. vulgare*	36		3,916	5	1	0.1
		lambsquarters	*Chenopodium album var. album*	37		1,342	32	4	11.04
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	34	0.01
		black bindweed	*Fallopia convolvulus*	50		100	1	1	2.4

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Water Transportation Facilities (21) (continued)	Aniak (13) (continued)	splitlip hempnettle	*Galeopsis bifida*	50		208	14	7	0.1
		fall dandelion	*Leontodon autumnalis*	51		617	7	1	0.01
		butter and eggs	*Linaria vulgaris*	69		1,912	6	1	0.1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	2	5
		common plantain	*Plantago major*	44		10,411	69	2	0.1
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	5	1.3
		common chickweed	*Stellaria media*	42		784	19	4	2.5
	Bethel (12)	Siberian peashrub	*Caragana arborescens*	74		83	2	1	0.12
		lambsquarters	*Chenopodium album var. album*	37		1,342	32	3	8.5
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	3	4
		fall dandelion	*Leontodon autumnalis*	51		617	7	3	1
		oxeye daisy	*Leucanthemum vulgare*	61		4,010	6	2	0.002
		pineappleweed	*Matricaria discoidea*	32		5,090	64	2	0.003

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Water Transportation Facilities (21) (continued)	Bethel (12) (continued)	common plantain	*Plantago major*	44		10,411	69	3	0.005
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	5	0.111
		creeping buttercup	*Ranunculus repens*	54		3,489	3	3	2.131
		sheep sorrel	*Rumex acetosella*	51		7,440	12	7	0.011
		curled dock	*Rumex crispus*	48		806	3	2	0.501
		common dandelion	*Taraxacum officinale*	58		21,964	43	1	1
	Chuathbaluk (4)	lambsquarters	*Chenopodium album var. album*	37		1,342	32	1	3.22
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	6	2.1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	3	0.5
		white clover	*Trifolium repens*	59		8,450	12	1	5.1
	Crooked Creek (8)	lambsquarters	*Chenopodium album var. album*	37		1,342	32	7	4.71
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	9	1.1
		foxtail barley	*Hordeum jubatum*	63		2,851	50	2	0.01
		butter and eggs	*Linaria vulgaris*	69		1,912	6	1	1.6
		pineappleweed	*Matricaria discoidea*	32		5,090	64	3	2

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Water Transportation Facilities (21) (continued)	Crooked Creek (8) (continued)	common plantain	*Plantago major*	44		10,411	69	3	1.01
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	3	1
		common chickweed	*Stellaria media*	42		784	19	1	0.1
	Kwethluk (7)	redroot pigweed	*Amaranthus retroflexus*	45		1	1	1	1.1
		shepherd's purse	*Capsella bursa-pastoris*	40		1,213	7	2	1.1
		big chickweed	*Cerastium fontanum spp. vulgare*	36		3,916	5	2	1.101
		fall dandelion	*Leontodon autumnalis*	51		617	7	3	0.1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	1	0.5
		common plantain	*Plantago major*	44		10,411	69	1	1.2
		sheep sorrel	*Rumex acetosella*	51		7,440	12	3	0.5
	Lower Kalskag (7)	big chickweed	*Cerastium fontanum spp. vulgare*	36		3,916	5	1	1
		lambsquarters	*Chenopodium album var. album*	37		1,342	32	1	0.02

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Water Transportation Facilities (21) (continued)	Lower Kalskag (7) (continued)	narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	2	0.01
		butter and eggs	*Linaria vulgaris*	69		1,912	6	1	1.5
		pineappleweed	*Matricaria discoidea*	32		5,090	64	2	1.5
		common plantain	*Plantago major*	44		10,411	69	2	0.1
		sheep sorrel	*Rumex acetosella*	51		7,440	12	1	1
	Napaimute (6)	lambsquarters	*Chenopodium album var. album*	37		1,342	32	1	0.11
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	2	0.1
		splitlip hempnettle	*Galeopsis bifida*	50		208	14	1	0.01
		oxeye daisy	*Leucanthemum vulgare*	61		4,010	6	1	0.5
		butter and eggs	*Linaria vulgaris*	69		1,912	6	1	1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	1	4
	Upper Kalskag (11)	big chickweed	*Cerastium fontanum spp. vulgare*	36		3,916	5	1	3.9
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	9	1
		foxtail barley	*Hordeum jubatum*	63		2,851	50	1	0.51

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Water Transportation Facilities (21) (continued)	Upper Kalskag (11) (continued)	oxeye daisy	*Leucanthemum vulgare*	61		4,010	6	2	1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	1	1
		common plantain	*Plantago major*	44		10,411	69	3	2.52
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	3	0.1
		curled dock	*Rumex crispus*	48		806	3	1	0.5
		common chickweed	*Stellaria media*	42		784	19	1	1
		white clover	*Trifolium repens*	59		8,450	12	1	1.1
		lambsquarters	*Chenopodium album var. album*	37		1,342	32	2	1.1
Pipeline (15)	Alaska Range, Middle Happy River (1)	pineappleweed	*Matricaria discoidea*	32		5,090	64	1	N/A
	Alaska Range, Squaw Creek (4)	pineappleweed	*Matricaria discoidea*	32		5,090	64	1	N/A
		common plantain	*Plantago major*	44		10,411	69	1	N/A
		annual bluegrass	*Poa annua*	46		5,946	1	1	N/A
		common dandelion	*Taraxacum officinale*	58		21,964	43	1	N/A

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Pipeline (15) (continued)	Georgetown (6)	lambsquarters	*Chenopodium album var. album*	37	AKEPIC	1,342	32	1	0.5
		butter and eggs	*Linaria vulgaris*	69		1,912	6	1	0.1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	3	2
		common plantain	*Plantago major*	44		10,411	69	2	1.5
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	1	0.5
		common chickweed	*Stellaria media*	42		784	19	2	1
		common dandelion	*Taraxacum officinale*	58		21,964	43	1	1.6
	Red Devil (8)	lambsquarters	*Chenopodium album var. album*	37		1,342	32	3	1.02
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	4	0.001
		splitlip hempnettle	*Galeopsis bifida*	50		208	14	1	1.6
		foxtail barley	*Hordeum jubatum*	63		2,851	50	4	5.2
		pineappleweed	*Matricaria discoidea*	32		5,090	64	5	2.1
		common plantain	*Plantago major*	44		10,411	69	4	1.5
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	3	0.5

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Pipeline (15) (continued)	Red Devil (8) (continued)	common dandelion	*Taraxacum officinale*	58		21,964	43	1	1.2
	Sleetmute (10)	lambsquarters	*Chenopodium album var. album*	37		1,342	32	4	2.51
		narrowleaf hawksbeard	*Crepis tectorum*	56		4,239	91	4	0.1
		splitlip hempnettle	*Galeopsis bifida*	50		208	14	1	1.5
		foxtail barley	*Hordeum jubatum*	63		2,851	50	2	1.1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	3	3.6
		common plantain	*Plantago major*	44		10,411	69	5	0.1
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	1	0.2
		common chickweed	*Stellaria media*	42		784	19	2	1.5
		common dandelion	*Taraxacum officinale*	58		21,964	43	2	0.5
		white clover	*Trifolium repens*	59		8,450	12	1	2.1
	Stony River (6)	lambsquarters	*Chenopodium album var. album*	37		1,342	32	3	0.01
		butter and eggs	*Linaria vulgaris*	69		1,912	6	1	1
		pineappleweed	*Matricaria discoidea*	32		5,090	64	1	1

Table 3.10-5: Known Occurrences of Invasive Species by Component

Project Component (No. Species)	Area or Watershed (No. Species)	Common Name	Scientific Name	Invasiveness Ranking[1]	Source[2,3]	Occurrences			Acres Infested
						Total Statewide	Total Project Area	Area or Watershed	
Pipeline (15) (continued)	Stony River (6) (continued)	common plantain	*Plantago major*	44		10,411	69	1	1
		prostrate knotweed	*Polygonum aviculare*	45		1,174	30	1	1
		common chickweed	*Stellaria media*	42		784	19	1	0.7
	Tyonek (13)	lambsquarters	*Chenopodium album var. album*	37		1,342	32	2	0.001

Notes:

1 Nawrocki et al. 2011 Carlson et al. 2008.
2 AKEPIC 2015.
3 Moody 2013, 2015.

3.10.2.7 RARE AND SENSITIVE PLANTS

There is only one federally listed rare plant species in Alaska, the Aleutian shield fern, a small fern known to occur only at two locations in the Andreanof Island group of the Aleutian Islands. There are no documented occurrences of this plant in the EIS Analysis Area and it is not expected to occur in the Project Area.

The AKNHP tracks population information on 318 rare plant species in Alaska (AKNHP 2015a; Nawrocki et al. 2013; Lipkin and Murray 1997). Several incidental observations of tracked vascular plant species were found during project wetland surveys (Table 3.10-6 and Figure 3.10-9).

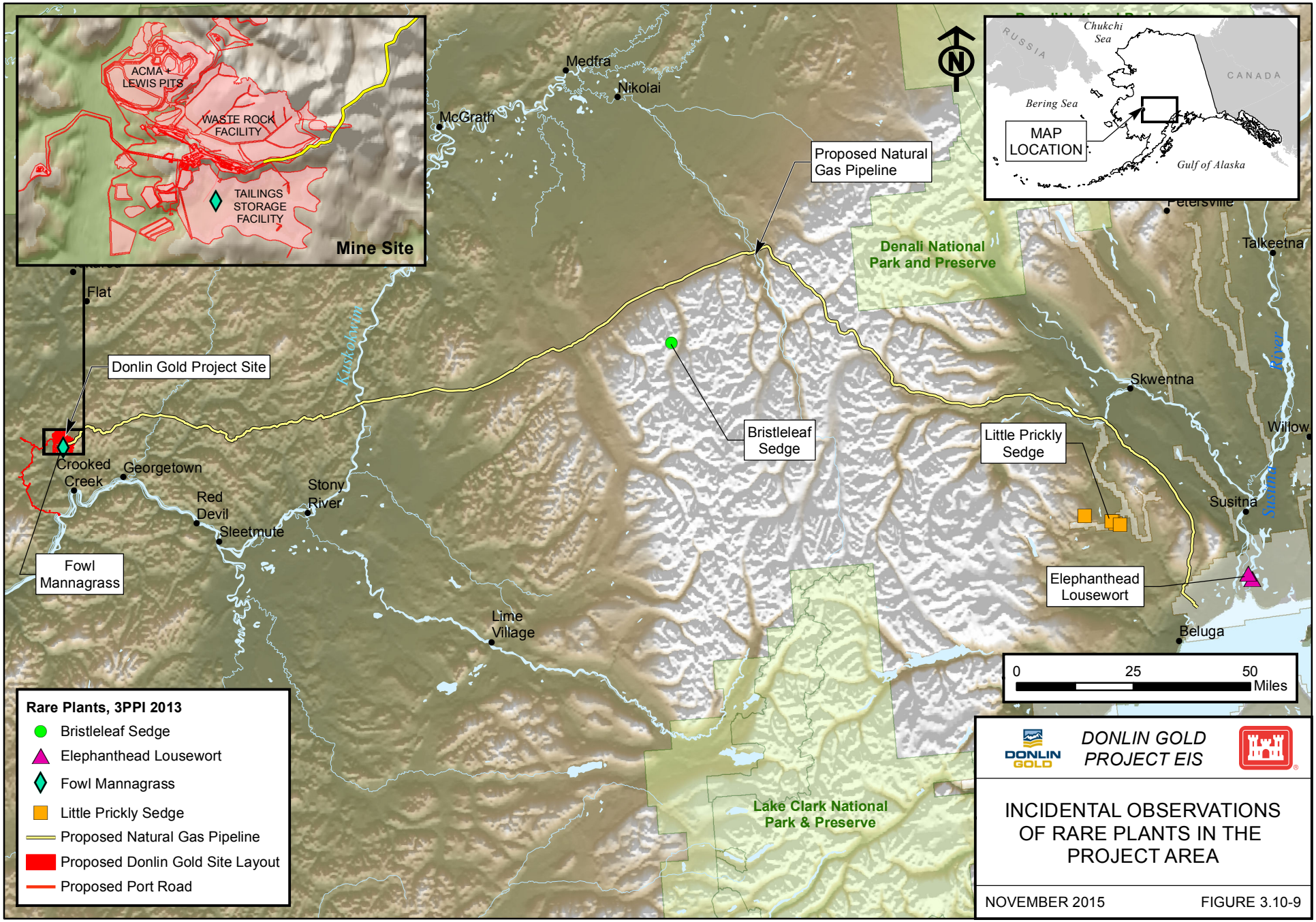
Table 3.10-6: Incidental Observations of Rare Species in the EIS Analysis Area

Number	Common Name	Scientific Name	AKNHP Ranking[1]	Ecoregion, Watershed and Basin
1	Fowl mannagrass	*Glyceria striata*	G5 S3	Kuskokwim Mountains Ecoregion, Crooked Creek, Anaconda Creek Basin (unconfirmed)
1	Bristleleaf sedge	*Carex eburnea*	G5 S3	Tanana-Kuskokwim Lowlands Ecoregion, Khuchaynik Basin, Khuchaynik Creek (unconfirmed)
1	Little prickly sedge	*Carex echinata ssp. echinata*	G5T5 S1S2	Cook Inlet Ecoregion, Lower Skwentna River, Basin, Canyon Lake-Skwentna River (unconfirmed)
3	Little prickly sedge	*Carex echinata ssp. echinata*	G5T5 S1S2	Cook Inlet Ecoregion, Lower Skwentna River Basin, Unnamed Trib #2 (confirmed – ALA Accession Numbers V171549, V171548, V171551)
1	Little prickly sedge	*Carex echinata ssp. echinata*	G5T5 S1S2	Cook Inlet Ecoregion, Lower Skwentna River Basin, Skwentna River(confirmed – ALA Accession Number V171550)
1	Elephanthead lousewort	*Pedicularis groenlandica*	G5 S2	Cook Inlet Ecoregion, Alexander Creek Basin, Wolverine Creek (confirmed – ALA Accession Number V171547)
1	Elephanthead lousewort	*Pedicularis groenlandica*	G5 S2	Cook Inlet Ecoregion, Alexander Creek Basin, , Lower Sucker Creek (confirmed – ALA Accession Number V171546)

Notes:

1 Rankings use a scale of S for State, G for Global; 1 for critically imperiled populations to 5 for secure populations. The T rankings are for subspecies or varieties.

Source: Moody 2013.


ACMA + LEWIS PITS
WASTE ROCK FACILITY
TAILINGS STORAGE FACILITY
Mine Site
Chukchi Sea
RUSSIA
CANADA
Bering Sea
MAP LOCATION
Gulf of Alaska
N
Medfra
Nikolai
McGrath
Proposed Natural Gas Pipeline
Denali National Park and Preserve
Talkeetna
Flat
Donlin Gold Project Site
Kuskokwim
Skwentna
Willow
Bristleleaf Sedge
Little Prickly Sedge
Crooked Creek
Georgetown
Red Devil
Stony River
Sleetmute
Susitna
Fowl Mannagrass
Elephanthead Lousewort
Lime Village
Beluga
Lake Clark National Park & Preserve
0
25
50
Miles
Rare Plants, 3PPI 2013
Bristleleaf Sedge
Elephanthead Lousewort
Fowl Mannagrass
Little Prickly Sedge
Proposed Natural Gas Pipeline
Proposed Donlin Gold Site Layout
Proposed Port Road
DONLIN GOLD
DONLIN GOLD PROJECT EIS
INCIDENTAL OBSERVATIONS OF RARE PLANTS IN THE PROJECT AREA
NOVEMBER 2015
FIGURE 3.10-9

No populations of tracked species of concern have been documented within 20 miles of the mine site or transportation facilities (AKNHP 2015a) except for a reported population of fowl mannagrass *(Glyceria striata)* along Anaconda Creek. A voucher specimen was not collected and this observation remains unconfirmed. The closest documented population of fowl mannagrass is in the Yentna Watershed, nearly 200 miles east of the observation on Anaconda Creek (AKNHP 2015a).

In the pipeline area, two rare species, bristleleaf sedge (*Carex eburnea*) and fragile rockbrake (*Cryptogramma stelleri*), have been documented near Farewell Lake, in the Tanana-Kuskokwim Lowlands ecoregion in prior surveys (AKNHP 2015a). An additional population of bristleleaf sedge was reported in the utility corridor 20 miles southwest of Farewell; a voucher specimen was not collected and this observation remains unconfirmed (Moody 2013). An unconfirmed population of little prickly sedge *(Carex echinata* ssp. *echinata*) was reported in the Lower Skwentna River basin near Canyon Lake. Voucher specimens were collected and verified for two populations each of little prickly sedge in the Lower Skwentna River basin and elephanthead lousewort *(Pedicularis groenlandica*) in the Alexander Creek basin. These were archived in the ALA Herbarium in Fairbanks (Moody 2013). Both species have also been separately documented within 30 miles of the proposed pipeline (AKNHP 2015a).

3.10.2.8 CLIMATE CHANGE

Climate change is affecting resources in the EIS Analysis area and trends associated with climate change are projected to continue into the future. Section 3.26 discusses climate change trends and impacts to key resources in the physical and biological environments including atmosphere, water resources, permafrost, and vegetation. Current and future effects on vegetation are tied to changes in physical resources (discussed in Section 3.26).

3.10.3 ENVIRONMENTAL CONSEQUENCES

This section describes potential impacts to vegetation as a result of the proposed Donlin Gold Project and its associated components. Each of the alternatives is addressed below.

In evaluating negative and positive impacts to vegetation resources, relevant factors for this project include:

- The area of the impacts. Project components cover varying areas of broad ecoregion system types.
- The type of impacts per vegetation community types. Some areas will be reclaimed, restored, or allowed to naturally revegetate. Some areas (e.g., maintained roads, buildings, the pit lake, and others) are not expected to be reclaimed or to revegetate.
- Permanent decrease in the quantity or volume of resources remaining. For example, certain vegetation community types, or wetlands, may not return to prior conditions.
- Increases in invasive species due to project activities, if mitigation measures are not adequately applied.
- Modifications or reduction in unique resources. For example, project activities may result in the permanent removal of a population of a sensitive plant species within the Project Area.

Impact criteria levels for vegetation were assessed by consideration of broad ecoregion system types, including ecosystems of conservation concern, and specific vegetation types and distribution for the southwest and southcentral Alaska regions that encompass the entire Project Area and EIS Analysis Area. Ecoregions that include broad vegetation descriptions and general regional characteristics, including general soil type, have been mapped and described in several publications (Boggs et al. 2008, 2014a, 2014b; Moore et al. 2004; Nowacki et al. 2001; Nowacki and Brock 1995; Gallant et al. 1995).

Southwest Alaska vegetation in the mine site and transportation facilities includes the Bristol Bay area, Kuskokwim Bay, and the extensive Yukon-Kuskokwim Delta region. Much of this region is low and poorly drained, with wetland vegetation community types common (Viereck et al. 1992). Vegetation inventory and classification work in this region, including rare plant and general species surveys, is extensive (Carlson et al. 2003, 2005, 2013; Boggs et al. 2003; Lipkin 1996, 2002; Viereck et al. 1992; Tande and Jennings 1986; Talbot et al. 1986; Byrd and Ronsee 1983; Wibbenmeyer et al. 1982; Hultén 1968).

Southcentral Alaska vegetation in the pipeline component includes a diverse area from the peaks of the Alaska Range to the coastal marshes of Cook Inlet. This area has had several comprehensive surveys to determine vegetation composition, species, and community types (DeVelice et al. 1999; Viereck et al. 1992; Viereck and Dyrness 1980; Hultén 1968).

Impact assessments were considered, analyzed, and determined from the perspective of overall regional Alaskan vegetation affected. In terms of regional vegetation, the mine site, transportation facilities, and pipeline vary in size and composition, but all are comprised of vegetation community types typical of and common to the region, based on review of available maps, publications, and surveys. The mine site occupies an extremely small proportion of typical vegetation for the region. The transportation facilities occupy a larger area, and the pipeline has the largest area of the three project components.

Table 3.10-7 summarizes the criteria used to determine the level of impact based on the intensity or magnitude, duration, geographical extent, and context of the impact.

Table 3.10-7: Impact Criteria for Effects on Vegetation

Type of Effect	Impact Component	Effects Summary		
Vegetation Removal or Accidental Fire	Magnitude or Intensity	**Low:** Impacts limited to removal of above-ground vegetation. Little or no soil disturbance.	**Medium:** Vegetation is removed both above and below ground, but area is reclaimed.	**High**: Vegetation is removed both above and below ground and is not reclaimed.
	Duration	**Temporary**: Vegetation would be affected briefly but not longer than the span of a few years and would be expected to return to pre-activity condition, such as areas cleared for construction only and reclaimed.	**Long-term**: Vegetation would be affected for up to the life of the project and would return to a functional condition after the completion of the activity.	**Permanent**: Vegetation would not be anticipated to return, such as the pit lake and areas of exposed rock.
	Geographic Extent	**Local:** Impacts limited to the Project Area.	**Regional:** Affects vegetation beyond the Project Area.	**Extended:** Affects vegetation beyond the footprint and EIS Analysis Area, possibly throughout a watershed.
	Context	**Common**: Affects common or ordinary vegetation and species; plant species are not rare, depleted in the locality or protected by legislation.	**Important**: Affects rare or depleted species/populations.	**Unique**: Affects species protected by legislation or the portion of the vegetation affected fills a unique ecosystem role within the locality or region.
Non-native Invasive Species Introduction or Spread	Magnitude or Intensity	**Low**: Any new invasive species introduced are limited to those ranked as weakly or very weakly invasive (invasiveness scores of 49 or below).	**Medium**: Modestly invasive species (scores 50-59) or moderately invasive (scores of 60-69) are introduced into new areas or existing infestations in the Project Area are allowed to spread.	**High**: Highly invasive species (scores 70 or above) are introduced into any area.
	Duration	**Temporary**: Vegetation would be affected during construction, but any new invasive species populations would be eradicated so vegetation would be restored to pre-activity condition.	**Long-term**: Invasive species persist in areas of continual disturbance such as roads, port, and airstrips but are eradicated during operations and closure.	**Permanent**: Invasive species are not controlled and spread beyond the Project Area.
	Geographic Extent	**Local**: Impacts limited geographically to the project footprint; invasive species do not spread beyond disturbed areas.	**Regional:** Affects vegetation beyond the project footprint.	**Extended:** Impacts affect vegetation well beyond the footprint and possibly throughout the EIS Analysis Area.

Table 3.10-7: Impact Criteria for Effects on Vegetation

Type of Effect	Impact Component	Effects Summary		
Non-native Invasive Species Introduction or Spread (continued)	Context	**Common**: Affects common or ordinary vegetation and species; plant species are not rare, depleted in the locality or protected by legislation.	**Important**: Affects rare or depleted species/populations within the locality or region.	**Unique**: Affects species/populations protected by legislation or the portion of the vegetation affected fills a unique ecosystem role within the locality or region.
Vegetation Community Composition Change (from accidental damage, dust or environmental contamination, changes in water availability, and reclamation)	Magnitude or Intensity	**Low**: Changes in plant communities may not be measurable or noticeable; limited to small areas or small number of species changed.	**Medium**: Noticeable changes in plant communities. Larger portions of communities are altered.	**High**: Acute or obvious changes in most of affected plant communities.
	Duration	**Temporary**: Plant communities would be affected briefly but not longer than the span of a few years and would be expected to return to pre-activity condition.	**Long-term**: Plant communities would be affected for up to the life of the project but would return to pre-activity condition after the completion of the activity.	**Permanent**: Plant communities would not be anticipated to return to previous condition.
	Geographic Extent	**Local**: Impacts limited to the project footprint.	**Regional:** Affects vegetation beyond the project footprint.	**Extended:** Impacts affect vegetation beyond the footprint and possibly throughout the EIS Analysis Area.
	Context	**Common**: Affects common or ordinary plant communities; vegetation types affected are not rare, depleted in the locality, or protected by legislation.	**Important**: Affects rare or depleted plant species or communities.	**Unique**: Affects plant species or community protected by legislation and/or the portion affected fills a unique ecosystem role within the locality or region.

3.10.3.1 ALTERNATIVE 1 – NO ACTION

Under the No Action alternative, the proposed project would not be constructed. Further exploration activities would not be precluded. Therefore, it would not have any new direct or indirect effects on vegetation.

3.10.3.2 ALTERNATIVE 2 – DONLIN GOLD'S PROPOSED ACTION

3.10.3.2.1 POTENTIAL IMPACTS

The following is a general description of the sources or mechanisms of potential impacts to vegetation. Details, such as acres or specific vegetation types affected, are described under each project component.

For each type of impact, the proposed design features that would mitigate or reduce the impact are also described. The impact levels assessed under each alternative are those that remain following implementation of the design features detailed in Chapter 2. Specific mitigation measures that would further reduce impacts are also discussed in Chapter 5, along with an evaluation of their expected effectiveness.

Vegetation Removal and Reclamation

The most direct impact to vegetation would be caused by the removal of vegetation during the clearing and grading of the construction areas. The construction ROW and work areas would be cleared and graded where necessary. Shrubs, trees, understory vegetation, roots, and other obstructions such as large rocks and stumps would typically be cleared from construction work areas.

In areas where the organic topsoil can be separated from mineral soils during excavation, this material would be recovered and stored for reclamation or, for the pipeline, would be placed as the surface portion of the backfill in the trench. Where this material is nonexistent or not recoverable, an attempt would be made to place finer-grained soils at the top of any backfill to facilitate revegetation.

Indirect effects could result from erosion of the exposed soil and sedimentation. Drainage and erosion control measures, both temporary and permanent, would be implemented at the mine site, transportation facilities, and along the pipeline and at facilities such as camps, storage yards, material sites, and airstrips. Donlin would develop Erosion and Sediment Control Plans (ESCP) and Storm Water Pollution Prevention Plans (SWPPP) prior to construction. These plans would outline erosion control Best Management Practices (BMPs) to minimize soil erosion after soil disturbance, such as the use of silt fences, bale check dams, swales, and trench and ditch reinforcement with geotextile fabric or rock gabions and sediment traps.

Vegetation removal can cause numerous changes in the surrounding environment, such as:

- Increased rate of soil erosion from wind or water;
- changes in water drainage patterns (increased runoff volumes);
- sediment deposition in downslope areas;
- melting of permafrost;
- changes in adjacent plant community composition;
- changes in wildlife habitat; and
- introduction and spread of invasive species.

As described in Donlin Gold's Reclamation and Closure Plan, reclamation of areas outside the Project Area would begin immediately after construction and continue through the closure, reclamation, and monitoring phase (closure phase). Reclamation would include grading to recontour as needed, distribution of slash and chipped vegetation, and fertilizing and reseeding as required. Seeding or planting of disturbed areas would be done in consultation with BLM and ADNR Plant Materials Center, following established revegetation and restoration BMPs for Alaska (Czapla and Wright 2012; Densmore et al. 2000; Wright 2008). Specific design features that incorporation restoration BMPs are listed in Chapter 5, Impact Avoidance, Minimization,

and Mitigation. Selected methods would promote natural succession or replanting of areas with native plant materials and seed mixes to limit the potential for introduction, establishment, or spread of invasive species. Specific requirements would be identified in Donlin Gold's Stabilization, Rehabilitation and Reclamation Plan.

Fertilizer would be applied in consultation with BLM and ADNR. Implementation of standard practices and planning as identified in the Stabilization, Rehabilitation and Reclamation Plan would ensure that the adequate volume, type, and quality of fertilizer would be used when and where needed. As project development proceeds, specific fertilizer uses would be determined and approved by ADNR/MLW for the mine site and mine infrastructure or ADNR/SPCO for the pipeline under their review of reclamation plans.

Cleared or graded vegetation to re-establishment time is variable but trees and shrubs are expected to begin to reestablish almost immediately after construction and reclamation. Alders, willows, and birch are generally the first trees and shrubs to re-establish. Tundra habitat including the vegetative mat may take several years to recover; the general time frame for recovery of disturbed tundra vegetation is around 5 to 10 years (Vavrek et al. 1999; Gartner et al. 1983; Chapin and Chapin 1980). In general, the recovery of vegetation following disturbance is related to the intensity of the disturbance and the resulting changes in moisture regimes (Lawson 1986). Tundra habitat recovery speed is dependent on many factors including retention of the vegetative mat, reclamation methods, and microsite characteristics. Reversion to or recreation of the original plant community is sometimes possible only when the original site characteristics such as moisture and topography are maintained.

Vegetation Removal Impacts Summary

The intensity of the impacts of vegetation removal would be high in areas that would have complete vegetation removal and no reclamation, such as permanent road corridors, certain mine site facilities, the pit lake, and the water treatment plant. Medium impacts are expected in areas with removal followed by reclamation, such as temporary road and facility construction areas, the pipeline corridor, or temporary buildings. Impacts would be low in areas with limited or short-term removal, including the transportation facilities area dock or port site construction or improvement areas, pipeline area small shoofly roads, temporary staging areas, or access roads or areas requiring vegetation removal or trimming where reclamation would begin as soon as possible after construction or operations end. The duration of the effects would range from temporary (during construction only) to long-term (for the duration of operations) to permanent for some areas, such as the pit lake. The geographical extent would be local to regional. After extensive review of existing inventory, survey, mapping, and community composition systems for the region, vegetation community types within the Project Area are determined to be common and widespread in the region, and no ecosystems of conservation concern have been identified. Therefore, context is common.

Overall, vegetation removal is expected to have a moderate impact on vegetation in the Project Area.

Reclamation Impacts Summary

Vegetation could also be adversely affected by stabilization, rehabilitation, or reclamation actions or by failure of reclamation. The magnitude would depend on the location and extent of damage. Impacts from reclamation failure are not expected to occur because the project's

Stabilization, Rehabilitation and Reclamation Plan would include monitoring to ensure reclamation success is achieved by taking adaptive action when needed.

Rare or Sensitive Species

Five species of plants tracked by AKNHP were recorded in the EIS Analysis Area but only two species have been confirmed. Although these species have been identified as rare by AKNHP, they are not afforded any special protections by any agency or organization in Alaska. The reported but unconfirmed fowl mannagrass occurrence would likely be impacted under all of the action alternatives. The other species observed were located outside of Project Area construction areas and would not be affected by any of the alternatives.

The BLM maintains a list of all-taxa sensitive species for Alaska, which includes 28 plant species. Habitat exists within the Project Area for several listed species. The BLM identified one particular species of concern due to rarity and potential habitat in the pipeline, pearfruit smelowskia (*Smelowskia pyriformis*). No BLM-listed sensitive plant species have been found in or near the Project Area, so no populations of BLM-listed sensitive plant species are expected to be affected in any action alternative.

Intensity, duration, and geographic extent for potential rare or sensitive species removal would be low; temporary (with mitigation by avoidance, replanting or transplanting); and local. These species (see Table 3.10-6) are considered important in context because their populations are suspected or known to be low within the EIS Analysis Area. Removal of any individuals would reduce the population size, which increases the risk of extirpation from the EIS Analysis Area. The five species are more common outside of the Project Area and Alaska, and not in danger of statewide or global extinction.

Invasive Species Introduction or Spread

A primary goal for vegetation management is preventing introduction and spread of non-native invasive species. Donlin Gold will produce a detailed all-taxa Invasive Species Management Plan (ISMP) as part of their Stabilization, Reclamation, and Rehabilitation Plan that incorporates design features to minimize and prevent invasions, Early Detection and Rapid Response (EDRR) principles, BMPs, and a Hazard Analysis and Critical Control Point (HACCP) plan designed with targeted outreach and management actions at critical control points. The ISMP would be common to all action alternative components, and address all invasive taxa (terrestrial, aquatic freshwater, and aquatic marine plants; terrestrial and marine aquatic animals). See Section 3.13, Fish and Aquatic Resources, for details on marine and freshwater aquatic invasive species.

Invasive Species Management Plan Elements

The ISMP would specifically include:

- Description of design features (listed below) that incorporate BMPs (listed in Chapter 5, Impact Avoidance, Minimization, and Mitigation) developed to reduce or eliminate introduction and spread;
- EDRR principles, based on guidance from the National Invasive Species Council (NISC) and other invasion prevention authorities;

- General BMPs for invasion prevention for all taxa;
- A HACCP plan delineating control points and practices;
- Guidance on applying practices based on existing invasive recommendations and regulatory framework in Alaska (ADNR 2014a; ADF&G 2002; Graziano 2011; Morgan and Sytsma 2010);
- Identification of Project Area vectors (see Vectors section below);
- Details on regular monitoring during all project phases to detect invasions before they establish or spread as part of EDRR;
- A strategy for addressing known existing invasive plant populations to minimize spread during project activities; and
- A decision framework for developing treatment plans to mitigate impacts, if any new invasions are detected, as controlling small infestations is more effective and economical than trying to control well-established, rapidly spreading infestations. Selected control measures will be based on species biology and the individual characteristics of the infestation.

Invasion Design Features and BMPs

Recommended design features that incorporate BMPs common to all action alternatives to prevent the introduction and spread of non-native invasive species, and to detect populations if introduced, include:

- Requiring infrastructure to provide for thorough cleaning, inspection, and documentation of equipment, vessels, vehicles, aircraft and materials used in the construction and operations phases; the purpose is to ensure all non-native invasive species propagules are removed at critical control points. Infrastructure may include wash stations, inspection stations, treatment tools, treatment equipment, storage facilities, identification training protocol, and staging locations;
- Specifying all critical control points, to be included in the HACCP;
- Requiring tracking of equipment/supply/vehicle/vessel shipments and mobilization from point of origin to arrival at destination;
- Requiring certified weed free products be used for any purpose during construction and operations phases for all vegetation removal and revegetation activities; and
- Requiring that annual or regularly scheduled monitoring and treatment protocols be delineated and implemented as part of EDRR for all taxa.

During the construction phase, BMPs that address invasive plant introduction or spread and vegetation disturbance would include, but are not limited to:

- Following guidelines in: Controlling the spread of Invasive Plants During Road Maintenance (Graziano et al. 2014);
- Following guidelines in: Vehicle Cleaning Technology for Controlling the Spread of Noxious Weeds and Invasive Species (USDA Forest Service 2005). This includes

identifying sites where equipment can be cleaned, plus a plan for seed and plant parts collection and disposal when practical;

- Following guidelines in: Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species (U.S. Bureau of Reclamation 2012). This includes removal of all mud, dirt, and plant parts from vehicles and equipment prior to moving it into the Project Area, and cleaning all equipment before relocating equipment to new sites within the Project Area, if operating in known infested areas;
- Following guidelines in: General Guidelines for the Establishment and Evaluation of Invasive Species Early Detection and Rapid Response Systems (NISC 2003);
- Following guidelines in: Guide to Noxious Weed Prevention Practices (USDA Forest Service 2001).
- Incorporation of invasive species prevention into road work layout, design, and decisions, including using known infested areas for staging, parking, and cleaning equipment. This also involves avoiding or minimizing all types of travel through known infested areas, or restricting travel to those periods when spread of seed or propagules is least likely; and
- Minimizing soil disturbance and retaining desirable vegetation in and around construction sites to the maximum extent possible; and avoiding soil removal from any infested areas to prevent spread off-site. When it is necessary to conduct soil work in infested areas, schedule activity when seeds or propagules are least likely to be viable and to spread.

During the operations and closure phases, BMPs in addition to those described in the Vegetation Removal section references include, but are not limited to:

- Following guidelines in: Replanting and maintenance of native communities (NOAA Fisheries Service BMP, http://www.habitat.noaa.gov/pdf/best_management_practices/Replanting%20Project%20Sites.pdf).
- Following guidelines in: Cleaning Land Vehicles, Equipment, and Personal Gear, NOAA Fisheries Service (http://www.habitat.noaa.gov/pdf/best_management_practices/Cleaning%20of%20Land%20Vehicles%20and%20Equipment.pdf); Inspection of Vehicles, Equipment, and Personal Gear, NOAA Fisheries Service, (http://www.habitat.noaa.gov/pdf/best_management_practices/Inspection%20of%20Vehicles%20and%20Equipment.pdf).
- Following guidelines in: Backcountry Road Maintenance and Weed Management (Ferguson et al. 2003).
- Revegetating disturbed soil in a manner that optimizes plant establishment for a specific site, unless ongoing disturbance will prevent establishment of invasive plants, following guidelines in: Replanting and Maintenance of Native Communities, NOAA Fisheries Service (http://www.habitat.noaa.gov/pdf/best_management_practices/Replanting%20Project%20Sites.pdf).
- Cleaning or sanitizing all clothing, boots, and equipment prior to visiting sites.

- Monitoring and evaluating success of revegetation, included as part of the Stabilization, Rehabilitation and Reclamation Plan; implementing a regular monitoring schedule during the Project and for three years after Project closure to ensure that any invasive species transported to the site are promptly detected and controlled.
- Inspection of any materials to be used in reclamation at the site of origin to ensure they are free of invasive material before use and transport; treating or avoiding infested sources.
- Requiring off-site materials to be certified weed-free and/or inspected prior to bringing to the Project Area.
- Minimizing roadside sources of seeds or plant material that could be transported to other areas within the Project Area.
- Periodical inspection of lesser-used roads, right of ways, landing strips, docks, or other control points, to be detailed in the HACCP.
- Keeping equipment on site during entire Project.
- When possible, to suppress growth of invasive plants and prevent their establishment, retaining relatively closed canopies.
- Reseeding, planting, or otherwise revegetating disturbed areas as soon as practicable after the seedbed has been prepared.
- Following ISMP guidance on the approach to managing existing invasive plant populations, such as containment, control, or eradication to prevent spread.

Additional BMPs specific to marine and freshwater aquatic invasions are described in Section 3.13, Fish and Aquatic.

Invasion Vectors

Invasive species could be introduced and spread by a variety of vectors throughout the Project Area. Common introduction locations include ports, docks, river banks, road corridors, airstrips, material sites, pipe storage yards, and camps. Areas with disturbed soils and/or open soil surfaces are especially vulnerable to invasive species infestation. Specific vectors include:

- Existing Populations – Pipeline activities have the potential to spread known infestations near Tyonek and in the vicinity of Dalzell Gorge. Water traffic and other activities have the potential to spread known infestations along the Kuskokwim River in the Water Transportation Corridor (Transportation Facilities Area). Mine Site activities have the potential to spread known populations to larger areas or new locations. Seeds or other propagules from existing populations could be dispersed by wind, water, waves, wildlife and bird movement, ocean currents, or by attachment to people, clothing, footwear, gear, or equipment.
- Equipment – Invasive species can be transported by construction equipment, field gear, imported materials, clothing, footwear, personal gear, fishing gear, and other items brought to the Project Area.
- Natural processes – Invasive species occasionally are transported by natural processes such as wind, water movement, waves and ocean currents, and bird and wildlife

transport. Marine invasive species such as cordgrasses or open-ocean species such as bryozoans may be transported by ocean currents to area adjacent to the Project Area. Invasive freshwater plant species such as elodea (*Elodea canadensis*, *E. nuttallii*, and hybrids) may be transported by waterfowl. See Section 3.13, Fish and Aquatic, for further discussion of aquatic freshwater and marine invasive species.

- Vehicles - Roads contribute to the spread of invasive species in two ways. Invasive species can grow in disturbed soil within the road corridor itself, usually at the edge. Typically, these species are adapted to disturbed areas and spread readily. In addition, roads are pathways for invasive species to be spread from other locations as people or vehicles incidentally move seeds or plant parts that are deposited along the road or are carried in/on equipment, supplies, or fill material.
- Freshwater Vessels – Boats can transport invasive plant seeds, invasive plant parts, and invasive animals that hitchhike in or on the vessel or gear used in the vessel. Docking sites and ports are especially vulnerable. Wind-dispersed species, which generally have a moderate to high invasiveness ranking (Nawrocki et al. 2011; Carlson et al. 2008), may be able to land on vessels and be transported more readily to new areas.
- Float Planes – Invasive plant fragments are commonly transported on float plane parts, including one particular species of concern, elodea. A 2014 U.S. Fish and Wildlife Service survey of a floatplane lake near Bethel revealed no elodea. However, there are many other water bodies used by floatplanes and boats in the vicinity of the Project Area that have not been surveyed for the presence or absence of aquatic invasive species, and planes may travel from known infestation areas to the Project Area. Float plane use associated with the project is expected to be low to none.
- Marine Vessels – Marine vessels take on and discharge millions of tons of ballast water daily in ports and harbors around the world. The discharge of ballast water is considered a major pathway for aquatic introductions because ballast water can contain aquatic plants, animals, and pathogens. ADEC regulations regarding ballast water discharge and BMPs would be followed to reduce the potential spread of aquatic invasive marine species. See Section 3.13, Fish and Aquatic Resources, for a detailed discussion of aquatic invasive species, including regulations governing ballast water management and high-risk species. Cordgrasses (*Spartina* spp.) are a potential plant risk species for the Project Area which could be transported by marine vessels.

Invasive Species Introduction or Spread Impacts Summary

The intensity of the impacts of introduction of non-native invasive species on vegetation could be high in locations with known existing highly invasive plant species (risk assessment scores above 70, which are essentially unknown in the Project Area), high concentrations of known invasive plant species (such as Tyonek or Bethel), or areas subject to vegetation removal, including the mine site components, road corridors, dock construction areas, staging areas, access locations, and other vegetation removal areas. Intensity would be medium to low in remote areas along the pipeline, and in transportation facilities areas where existing invasions are unknown or minimal. Duration of impacts would be temporary to long-term, depending on timing of reclamation and revegetation. In areas not subject to reclamation, duration would also be temporary to long-term due to application of EDRR and BMPs. The geographic extent would be local, but could be regional if EDRR principles or mitigation are not adequately applied. The

context is common, as invasive species are not expected to impact overall community composition.

Overall, invasive species introduction or spread would have a minor impact with application of EDRR, BMPs, design features, and a detailed ISMP in any action alternative.

Accidental Vegetation Damage

The primary incidents that could result in serious harm or damage to vegetation include fire, accidental spills, or inappropriate forestry practices. Equipment used during construction may also result in accidental damage to vegetative cover. The effects of any of these incidents could be loss or damage from small to large areas of vegetation adjacent to project components. Spill scenarios and potential impacts are described in Section 3.24, Spill Risk.

Accidental fire could spread beyond the Project Area. Fire prevention measures would be implemented for all three project components. At the mine site, all structures would be designed in compliance with State of Alaska Building Codes and approved by the State Fire Marshal's office. Fire control and suppression would be coordinated by an on-site fire brigade. In addition, all personnel would receive instruction in fire and emergency procedures during their Mine Safety and Health Administration (MSHA) training. In addition to an on-site fire truck, heavy mine equipment would be available for fire control and suppression. This equipment would include rubber-tired dozers, tracked dozers, graders, and loaders in addition to a 20,000 gallon water truck with pumps, water cannons, and hoses. A heated and insulated aboveground 237,800 gallon dedicated water storage tank would provide water for fire protection at the Angyaruaq (Jungjuk) Port. All heavy equipment would be equipped with automatic and/or manually activated fire suppression systems, and hand-held extinguishers would be installed in all heavy equipment and small vehicles. Automatic sprinklers would be installed in buildings and, where appropriate, fire extinguishers would be mounted on the walls of all buildings. Fire hydrants would be located near the mill/administration building complex and the conveyor drive tower. For the pipeline, a Fire Prevention and Suppression Plan would be implemented. Donlin Gold would take all actions necessary or appropriate for the prevention and suppression of fires in accordance with applicable law and instructions from appropriate authorities.

To follow good forestry practices that minimize forest insect spread and reduce the risk of wildfire, Donlin Gold would apply the provisions of Alaska State Code Title 11, Chapter 95, Section 195, 11 AAC 95.195, Clearing of spruce trees, as applied to spruce trees other than black spruce. All work would be performed in accordance with relevant permit and lease stipulations consistent with the Donlin Gold Timber Utilization Plan.

The intensity of the impacts of accidental vegetation damage could range from low to high depending on the type of damage. Construction damage, small fires, or minor forestry practice issues would have a low intensity. Large or severe fires could have high intensity if the fire affects below-ground vegetation and soil. The duration of the effects could range from temporary (during construction only) to long-term (for the duration of operations). The geographical extent would be local to regional. Context is common. Given the BMPs proposed to minimize damage, the summary impact level for accidental damage impacts on vegetation is moderate.

Fugitive Dust and Environmental Contamination

Fugitive dust emissions are an inevitable by-product of construction and. Dust would be caused by vehicle travel on the port road, pipeline access roads, and other unpaved surfaces, as well as mining activities at the pit, which are also a potential source of dust emissions. This dust has the potential to collect on vegetation in the vicinity of the dust sources. Windblown dust could affect vegetation well beyond the source, but the effect diminishes with distance and is affected by prevailing winds and topography. The deposition of dust has been analyzed in Section 3.2, Soils.

Dust can have a number of impacts on vegetation, including:

- elimination of vegetation in heavy dust area, early snowmelt and early green-up along roadsides with dust shadow, decrease in mosses and lichens, and decrease in contributions to thermokarst (Walker and Everett 1987);
- reduction in biomass, increase in graminoids and decrease in soil nutrients (Auerbach et al. 1997);
- reduction in the plants' photosynthetic abilities which then affects growth (Myers-Smith et al. 2006);
- decreases in soil moisture, increases in thaw depths; and
- increases in toxicity if the dust is chemically active (highly acidic or highly alkaline or high in certain metals).

The cumulative impact of dust loading is a reduction in the plants' photosynthetic abilities and therefore growth. While it is difficult to predict the cumulative effect of fugitive dust emissions on vegetation, it is likely that plant growth retardation and changes in plant communities could occur in some areas immediately bordering dust source areas.

Measures to reduce dust would include limiting soil disturbance, stabilizing all disturbed surfaces, limiting traffic, using water trucks to spray road surfaces, and using snow or other approved dust suppressants to cover disturbed areas to minimize movement of exposed soils.

The intensity of the impacts of fugitive dust on vegetation is expected to be low to medium. The duration of the effects would be long-term. The extent would be either local or regional. Context is common. Fugitive dust is expected to have a summary minor impact on vegetation, given the dust control measures proposed.

Dust may be a source of contamination that could affect vegetation, including mercury or other metals deposited in dust. Mercury is present in the rocks that will be mined in the form of cinnabar. Therefore, mercury would be expected in the dust from mining and at various points in the processing of the ore. Control systems will be included at all points in the process where mercury might be emitted. Those controls, described in Hatch and Donlin Gold 2014 (Hatch 2014), are expected to remove 99.6 percent of all mercury processed and outperform national standards established by the EPA in 2011. Arsenic is also present in native soils. The effects on soils of metals in dust deposition have been analyzed in Section 3.2, Soils, concluding that the levels of metals increase by small percentages. Those results were used in Section 3.12, Wildlife, to evaluate the potential effects on terrestrial organisms. The conclusions for terrestrial plants, invertebrates, birds, and mammals is that the deposition of particulates on surface soil

surrounding mine operations is not expected to pose a risk to terrestrial organisms different from the risk from baseline concentrations.

Changes in Water Availability

The proposed project could cause changes in the quantity and distribution of surface water flows in the proposed Project Area by:

- reducing baseflows due to dewatering of the mine pit area;
- reducing mine-site runoff;
- diverting stream flow or downslope water movement from its natural drainage; and
- consuming water in the mine's processing facilities.

Changes in the distribution of surface flows would be caused by diverting water and altering the area's topography during development of the project facilities. Changes in surface water hydrology would be highest within the American Creek, Omega Gulch, parts of Crooked Creek, Anaconda Creek, Snow Gulch, and Crevice Creek drainages; surface water hydrology impacts would be much less pronounced when examining the overall hydrology of Crooked Creek or the Kuskokwim River.

Changes in surface water hydrology, described in Section 3.5, Surface Water Hydrology, could result in alterations to vegetation. Plant communities could change in affected areas as moisture regimes are altered. In some areas, vegetation could shift from a wetland plant community to a non-wetland plant community, or the reverse. Indirect effects would result from modifications to the hydrology in areas immediately adjacent to disturbed areas. For example, road fill would disrupt subsurface flows causing ponding upslope and dewatering downslope. This could change the composition of vegetation communities adjacent to the road. Design measures include features to minimize these effects, and the extent of such changes cannot effectively be quantified prior to construction. Changes would be site specific and dependent on the size of the drainage area, slope, and soil characteristics.

Design features incorporated to minimize the alteration of hydrology in the area include:

- Proper siting and maintenance of drainage structures for the proposed roads;
- Siting access routes, airstrips, and other infrastructure facilities to avoid wetland areas to the extent feasible;
- Whenever possible, cross drainages at right angles, and use bridges;
- Selecting material site (i.e., borrow) locations to avoid wetlands where feasible;
- Routing transmission lines in proximity to the road, where possible, to reduce wetland footprints and reduce the number of drainages affected by the project;
- Using brush berms along the toe of fills, where feasible, to control erosion;
- Restoring flat-to-gently sloping wetlands by removal of fill at project closure where feasible; and
- Developing multiple use facilities – using the same piece of ground for more than one purpose over the life of the mine.

The intensity of the impacts of changes in water availability on vegetation could range from low to high depending on the amount of water moved. The duration of the effects would be long-term, or be permanent for areas with permanent topographic changes. The impacts would be regional, and common in context. Changes in water availability are expected to have a minor to moderate impact on vegetation.

Climate Change Summary for Alternative 2

Predicted overall increases in temperatures and precipitation and changes in the patterns of their distribution (McGuire 2015; Chapin et al. 2006, 2010; Walsh et al. 2005) have the potential to influence the projected effects of the Donlin Gold Project on vegetation and wetlands. An overall warming/drying trend would tend to convert some wetlands to uplands and tend to increase the cover of shrubs and trees in previously open areas. Warming may also increase the thawing of permafrost over time. In project areas like the pipeline, increased thawing might lead to more open water areas. An increase in wildfire frequency or size due to drying may increase the potential for invasive species introduction and spread. See Section 3.26 (Climate Change) for further details on climate change and resources.

3.10.3.2.2 SPECIFIC EFFECTS

The effects of Alternative 2 on vegetation are described qualitatively in the text and quantitatively in the tables. The quantitative impacts of each project component were calculated by overlaying the project component footprints of each alternative onto the vegetation mapping and calculating the area of each vegetation type within the footprints.

Mine Site – Construction; Operations and Maintenance; and Closure, Reclamation, and Monitoring

Vegetation at the mine site would be directly affected by removal and reclamation, and indirectly affected through increased risk of accidental damage, increased invasive species introduction and spread risk, fugitive dust, increased risk environmental contamination, and changes in water availability.

Figure 3.10-3 shows the mine site footprint overlain on the mapped vegetation types. Table 3.10-8 lists acres of vegetation by type that would be removed, mostly coniferous forest, with some shrub and deciduous/mixed forest, and small amounts of herbaceous and other land cover impacted. This table also illustrates the small proportion affected of each vegetation community type within the greater watershed; under one percent of the greater watershed (the Lower Kuskokwim watershed) is impacted for any vegetation type.

Table 3.10-8: Alternative 2 Mine Site Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation Within Watershed*
Lower Kuskokwim Watershed		
Forested – Deciduous/Mixed	841.3	0.367
Forested – Coniferous	6,259.2	0.451
Shrub	1,498.4	0.097
Herbaceous	181.2	0.714
Other Land Cover	174.4	0.180
TOTAL:	8,954.6	

Notes:
* Watershed data from Boggs et al. 2014b. Vegetation Map and Classification: Northern, Western and Interior Alaska, 2014 Update.

Source: 3PPI 2014b.

The only rare plant observed in the mine site area is an unconfirmed population of fowl mannagrass observed near Anaconda Creek (see Figure 3.10-9), located in the footprint of the proposed TSF. This population would be removed. This species does not have any protected status although mitigation such as replanting or reseeding would be possible.

The intensity of effects on vegetation at the mine site would be high, as all the vegetation would be removed. Removing the population of fowl mannagrass (if confirmed) would be a medium-intensity impact because it is a species much more common in other areas. Fugitive dust could have low to medium intensity impacts because it may cause variable physiological changes to vegetation pending exposure length or level. Introduction of invasive species and accidental damage to vegetation could have medium to high intensity impacts if mitigation measures and BMPs are not followed. Changes in water availability could alter plant communities over a larger area (see Figures 3.11-17 and 3.11-18, in Section 3.11, Wetlands) and have low to medium impacts.

The duration of effects on vegetation at the mine site would range from temporary to permanent. After mine closure the area would be reclaimed including re-contouring roadways and planting native vegetation and reseeding disturbed areas with native seeds. While these areas are expected to revegetate, they are not likely to have the same plant composition or structure as they did prior to disturbance. The area occupied by the pit lake would not revegetate, and therefore impacts would be permanent. Removal of rare species would be permanent. Invasive species infestation or vegetation damage could be long-term to permanent, and fugitive dust impacts would be long-term during the life of the mine. Changes in water availability would be long-term to permanent.

The geographic extent of effects on vegetation at the mine site would be local; however, regional impacts are possible if invasive species spread beyond known locations or become established in new areas. Vegetation affected at the mine site would be common in context due to the widespread presence of inventoried vegetation community types within the mine site area (aside from the unconfirmed fowl mannagrass, in which case context would be important).

Summary of Impacts for Mine Site

The direct and indirect effects from the mine site on vegetation would be medium in intensity. Some areas would experience temporary effects during construction while others would be affected long-term or permanently. The geographical extent would be local but could become regional if invasive species spread beyond known locations or become established in new areas; invasion is expected to be minimized because of the BMPs, design features, and the ISMP that would be implemented. While mostly common vegetation species would be affected, one unconfirmed occurrence of a rare plant species (considered important) would be impacted. The summary impacts of the mine site on vegetation would be moderate.

Transportation Facilities – Construction; Operations and Maintenance; and Closure, Reclamation and Monitoring

Vegetation in the transportation facilities area (airstrip, mine access road, Bethel Port expansion area, Angyaruaq (Jungjuk) Port) would be directly affected by removal and reclamation, and indirectly affected through increased risk of accidental damage and invasive species introduction and spread, increased fugitive dust, and changes in water availability.

Figure 3.10-4 shows the transportation facilities footprint overlain on the mapped vegetation types. Table 3.10-9 lists acres of vegetation by type that would be removed, a mix of coniferous forest, shrub, and deciduous / mixed forest, with very little herbaceous and other land cover impacted. This table also illustrates the extremely small proportion (by percent) affected of each vegetation community type within the greater watershed.

Table 3.10-9: Alternative 2 Transportation Facilities Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation Within Watershed*
Lower Yukon Watershed		
Forested – Deciduous/Mixed	2.2	0.00006
Forested – Coniferous	92.2	0.001
Shrub	86.3	0.001
Herbaceous	0.0	0.000
Other Land Cover	0.04	0.000001
Lower Kuskokwim Watershed		
Forested – Deciduous/Mixed	122.8	0.054
Forested – Coniferous	356.1	0.026
Shrub	206.9	0.013
Herbaceous	3.2	0.013
Other Land Cover	2.6	0.003
TOTAL:	872.4	

Notes:

* Watershed data from Boggs et al 2014b. Vegetation Map and Classification: Northern, Western and Interior Alaska, 2014 Update.

Source: 3PPI 2014b.

The intensity of effects on vegetation in the transportation facilities area would be high where vegetation is removed or where changes in water availability alter plant communities. Fugitive dust could have low to medium intensity impacts because it may cause variable physiological changes to vegetation pending exposure length or level. There are no rare or sensitive species recorded within the transportation facilities area. Introduction of invasive species and accidental damage to vegetation could have medium to high intensity impacts if mitigation measures or BMPs are not followed.

The duration of effects on vegetation in the transportation facilities area would range from temporary to permanent. In some locations during operations and after closure most disturbed areas would be reclaimed including re-contouring roadways and reseeding disturbed areas with native seeds. While these areas are expected to revegetate, they are not likely to have the same plant composition or structure as they did prior to disturbance. The geographic extent of effects on vegetation in the transportation facilities area would range from local to regional if invasive species spread beyond known locations or become established in new areas or accidental fires spread outside the Project Area. The context of effects on vegetation is common as there are no known occurrences of rare or sensitive species, and inventoried vegetation community types are common in the transportation facilities area.

Summary of Impacts for Transportation Facilities

The direct and indirect effects of the transportation facilities on vegetation would be medium in intensity. Some areas would experience temporary effects while others would be affected long-term or permanently. The geographical extent would local but could become regional if invasive species spread beyond known locations or become established in new areas or accidental fires spread outside the Project Area. Invasion risk is expected to be minimized because of the BMPs, design features, and ISMP that would be implemented. The context for impacts would be common, with only common vegetation community types impacted. The summary impacts of the transportation facilities on vegetation would be moderate.

Pipeline – Construction; Operations and Maintenance; and Closure, Reclamation, and Monitoring

Vegetation along the proposed 315-mile long natural gas pipeline would be directly affected by removal and reclamation, period maintenance (brushing), and potential removal of rare or sensitive species. Indirect impacts would include increased risk of invasive species introduction and spread, fugitive dust during construction and operations, and changes in water availability. Figure 3.10-5A through Figure 3.10-5G show the proposed pipeline footprint overlain on detailed mapped vegetation types. Table 3.10-10 lists acres of vegetation by type that would be removed, almost evenly distributed between deciduous / mixed forest, coniferous forest, and shrub, with small amounts of herbaceous and other land cover impacted.

The pipeline differs from the other project components in that a much larger area would be affected temporarily during construction than would be affected long-term by operations. Once the pipeline is buried after construction, most of the disturbed area would be revegetated using native seeds, fertilizer, and mulch as required.

Populations of two rare species tracked by the AKNHP, little prickly sedge (*Carex echinata ssp. Echinata*) and elephanthead lousewort (*Pedicularis groenlandica*), were documented in the

pipeline study area during the wetland survey (see Figure 3.10-9). Both populations are located outside the construction area and would not be affected.

Table 3.10-10: Alternative 2 Pipeline Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation Within Watershed*
Western Cook Inlet Watershed		
Forested - Deciduous/Mixed	74.5	0.056
Forested - Coniferous	6.8	0.010
Shrub	9.2	0.003
Herbaceous	0.9	0.0002
Other Land Cover	15.2	0.038
Susitna River Watershed		
Forested - Deciduous/Mixed	980.9	0.053
Forested - Coniferous	179.3	0.007
Shrub	772.7	0.014
Herbaceous	69.8	0.005
Other Land Cover	5.2	0.0004
Upper Kuskokwim Watershed		
Forested - Deciduous/Mixed	548.6	0.013
Forested - Coniferous	1,272.5	0.010
Shrub	1080.8	0.030
Herbaceous	112.1	0.007
Other Land Cover	44.1	0.002
Lower Kuskokwim Watershed		
Forested - Deciduous/Mixed	91.6	0.027
Forested - Coniferous	109.8	0.004
Shrub	560.5	0.030
Herbaceous	22.8	0.061
Other Land Cover	6.6	0.004
TOTAL:	5,963.8	

Notes:

* Watershed data from Boggs et al 2014b. Vegetation Map and Classification: Northern, Western and Interior Alaska, 2014 Update.

Source: 3PPI 2014b.

Table 3.10-10 also illustrates the small proportion affected of each vegetation community type within the greater watershed. For example, the 1,272.5 acres of coniferous forest impacted in the Upper Kuskokwim Watershed represents only 0.02 percent of the total amount of coniferous forest in that watershed.

The intensity of effects on vegetation along the proposed pipeline would be high where vegetation is removed or changes in water availability alter plant communities. Fugitive dust could have low to medium intensity impacts because it may cause variable physiological changes to vegetation pending exposure length or level. Introduction and spread of invasive species could have medium to high intensity impacts, but invasion is expected to be minimized because of the BMPs, design features, and the ISMP that would be implemented.

The duration of effects on vegetation along the proposed pipeline would range from temporary to permanent. After construction, most areas would be reclaimed allowing vegetation composition to return to pre-construction conditions as much as site conditions allow. Access roads would be reclaimed shortly after construction and would be allowed to revegetate. Vegetation in small areas with above-ground infrastructure would be affected long-term. Areas where soil conditions are changed are expected to revegetate, but may not have the same vegetation composition as they did prior to disturbance, and changes would be permanent.

The geographic extent of effects on vegetation along the pipeline would range from local to regional. Impacts would be local, although regional effects are possible if invasive species spread beyond known locations or become established in new areas or accidental fires spread outside the proposed Project Area. The context would be common.

Summary of Impacts for Pipeline

The direct and indirect effects of the proposed pipeline on vegetation would be low to medium in intensity. Some areas would experience temporary effects during construction while others would be affected long-term or permanently. The geographical extent would be local but could become regional if invasive species spread beyond known locations or become established in new areas or accidental fires spread outside pipeline area. Context would be common. The summary impacts of the pipeline on vegetation would be moderate.

Summary of Impacts for Alternative 2

Table 3.10-11 presents the impact levels of Alternative 2 by impact type and project component. Moderate direct and indirect impacts would occur in all three project components. In the event of accidental fires or uncontrolled invasive species introduction or spread, design features, management plans, and BMPs would maintain impacts as moderate rather than major

These effects determinations take into account impact-reducing design features (see Table 5.2-1 in Chapter 5, Impact Avoidance, Minimization, and Mitigation) proposed by Donlin Gold and also the Standard Permit Conditions and BMPs (Section 5.3 in Chapter 5, Impact Avoidance, Minimization, and Mitigation) that would be implemented. Donlin Gold's Fire Prevention and Suppression Plan would mitigate accidental fire risk. Design features most important for reducing impacts to vegetation include:

- Pre-construction surveys of vegetation to be disturbed on BLM-managed land would be conducted to determine the presence or absence of any rare and sensitive plant species. If any individuals or populations are found, the appropriate agencies would be consulted to determine potential mitigation such as avoidance or transplant. These mitigation measures could substantially reduce the potential effects on any rare plants.
- All work would be performed in accordance with relevant permit and lease stipulations and in a manner to minimize potential infestation of spruce bark beetle or other

potential pest problems consistent with the Donlin Gold Timber Clearing Utilization Plan.

- Salvaged growth media and topsoil removed during construction would be stored adjacent to revegetation sites and used for revegetation as soon as possible. Native seed mixes and natural recolonization would be utilized to the extent possible in reclamation activities.
- Areas of disturbed bedrock and surficial deposits along the ROW, roads, and material sites would be contoured to match existing landforms as feasible, ripped to mitigate compaction effects, covered with growth media as needed and revegetated, and would support the overall drainage of the site, the long-term geotechnical stability, and post-mining land use.
- Post-closure sediment controls would include site grading and capping of erodible material, revegetation, and re-routing of surface runoff to reestablish natural conditions.
- In final design, site infrastructure, material sites, and roads would avoid ground-disturbing activity in wetland areas whenever practicable. Details would be developed as the mitigation plan is developed and as design and permitting progress. Those details do not exist at the Draft EIS stage.
- During the operations phase, concurrent reclamation activities (e.g., certain tiers and areas within the WRF) would be conducted immediately after construction and stabilization and whenever practicable in areas no longer required for active mining.
- Design for closure would occur even before construction for reclamation and closure planning at the mine site, incorporates, incorporating methods for safe and efficient closure of the mine as an integral part of the planned mine design and operations to minimize disturbance and the re-handling of materials.
- At the completion of contouring of the WRF and TSF, a layer of unconsolidated material from the North and South overburden stockpiles would be spread over the surface that would be overlain with an additional layer of growth media (topsoil and overburden). This material would be tested to ensure it is non-PAG. The WRF would be designed to maximize concurrent reclamation, minimize the effects of PAG materials, minimize infiltration and erosion, and promote controlled surface runoff and revegetation.
- The pipeline ROW would be reclaimed immediately following construction (in the same or the next season) to minimize erosion effects on exposed bedrock and surficial deposit cuts.
- The project design includes in-place abandonment of all subgrade pipeline; eliminating impacts that would occur if pipe were removed.

Standard Permit Conditions and BMPs most important for reducing impacts to vegetation include:

- Implementation of Stormwater Pollution Prevention Plans (SWPPPs) and/or Erosion and Sediment Control Plans;
- Development and maintenance of ODPCPs, SPCC Plans, and FRPs;

- Use of BMPs such as revegetation planning, watering and use of dust suppressants to control fugitive dust;
- Preparation and implementation of a Stabilization, Rehabilitation, and Reclamation Plan; and
- A comprehensive ISMP.

3.10.3.2.3 ADDITIONAL MITIGATION AND MONITORING FOR ALTERNATIVE 2

The Corps is considering additional mitigation (Table 5.5-1 in Chapter 5, Impact Avoidance, Minimization, and Mitigation) to reduce the effects presented above.

- Restore flat-to-gently sloping wetlands by removal of fill at project closure where feasible. Removed fill would be moved to approved upland areas. Details would be developed as Donlin Gold's Conceptual Compensatory Mitigation Plan is developed and as design and permitting progress. Those details do not exist at the DEIS stage.
- Restore flat-to-gently sloping wetlands by removal of fill at project closure where feasible. Removed fill would be moved to approved upland areas. Details would be developed as Donlin Gold's Conceptual Compensatory Mitigation Plan is developed and as design and permitting progress. Those details do not exist at the DEIS stage.
- Riparian bank vegetation material would be left intact or stored for replacement on the disturbed banks to stabilize and restore the crossing. Monitoring of crossing sites to identify sites that need additional restoration to prevent bank erosion would be implemented after construction. At stream bank crossings, placement of riparian mats or root masses would prevent and facilitate rapid vegetation regrowth to prevent bank erosion.
- Use mats or other appropriate types of ground protection to minimize disturbance to ground vegetative cover during non-winter construction.
- Salvage and replace the native vegetation mat in wetlands, and/or reestablish wetland vegetation that is typical of the general area, where practicable.
- Reduce construction ROW width to 85 feet where protective mats are required to minimize disturbance to ground vegetative cover, where practicable.
- Mark vegetation clearing limits with flagging or other markers to prevent crews from damaging more vegetation than needed during construction.
- Develop and maintain a native species seed bank for reclamation and restoration practices. Develop and implement test vegetation plots to determine potential revegetation success with native and local plant material and seeds (including lichens and mosses).
- For winter pipeline construction access roads, frost pack muskegs and wetlands (the combination of covering with snow and driving on it causes freezing at depth and provides a slightly elevated running surface) to minimize impacts to vegetative ground cover and wetlands.

- Where feasible include mannagrass (*Glyceria striata*) species or other confirmed sensitive and rare plant species identified in the Project Area as part of the seed mix used in the Stabilization, Rehabilitation, and Reclamation Plan to mitigate for loss of habitat.
- Promote salvaging and re-spreading topsoil over the overburden piles and allowing native vegetation and native seed planting vegetation growth to keep topsoil viable until it is needed during final reclamation. In pipeline reclamation practices, segregate windrowed organic soils as cover material (where present). Unless this material comes from the existing topsoil, it should not be used on the top of the trench as subsoil has no viable seed or other organic matter. Good construction practices include taking time to blade the layer of topsoil before trenching the pipeline.

If these mitigation and monitoring measures were adopted and required, the summary impact rating for the mine site, transportation facilities, and pipeline would be reduced, but would remain moderate. The Corps is not considering additional monitoring (Table 5.7-1 in Chapter 5, Impact Avoidance, Minimization, and Monitoring) to reduce the effects presented above.

Table 3.10-11: Impact Levels of Alternative 2 by Impact Type and Project Component

Impact Type	Impact Level by Factor				
	Magnitude or Intensity	**Duration**	**Geographic Extent**	**Context**	**Summary Impact Rating[1]**
Mine Site					
Vegetation removal (8,954.6 acres)	High in areas cleared and excavated without reclamation (Medium in areas excavated but reclaimed).	Temporary (construction clearing) to Long-term (areas to be rehabilitated after closure) or Permanent (excavation site, pit lake).	Local	Common	Moderate
Rare or sensitive species removal	Medium	Permanent	Local	Important	Minor (unless rare species are confirmed)
Non-native invasive species introduction or spread	Medium to High	Long-term to Permanent	Local to Regional	Common	Minor to Moderate
Accidental damage	Medium to High	Temporary to Long-term	Local to Regional	Common	Moderate
Fugitive dust or environmental contamination	Low to Medium	Long-term	Local to Extended	Common	Minor to Moderate
Changes in water availability	Low to High	Long-term to Permanent	Local to Regional	Common	Moderate

Table 3.10-11: Impact Levels of Alternative 2 by Impact Type and Project Component

Impact Type	Impact Level by Factor				
	Magnitude or Intensity	Duration	Geographic Extent	Context	Summary Impact Rating[1]
Transportation Facilities					
Vegetation removal (872.9 acres)	Low in areas cleared, Medium in areas excavated but reclaimed, High in areas cleared and excavated without reclamation.	Temporary to Long-term	Local	Common	Moderate
Non-native invasive species introduction or spread	Medium to High	Long-term to Permanent	Local to Regional	Common	Minor to Moderate
Accidental damage	Medium to High	Temporary to Long-term	Local to Regional	Common	Minor to Moderate
Fugitive dust or environmental contamination	Low to Medium	Long-term	Local to Regional	Common	Minor to Moderate
Changes in water availability	Low to High	Temporary to Permanent	Local to Regional	Common	Minor to Moderate
Pipeline					
Vegetation removal (5963.8 acres)	Low in areas cleared, Medium in areas excavated but reclaimed, High in areas cleared and excavated without reclamation.	Temporary to Long-term	Local	Common	Moderate
Rare or sensitive species removal	High	Permanent	Local	Important	Minor (unless rare species are confirmed)
Non-native invasive species introduction or spread	Medium to High	Long-term to Permanent	Local to Regional	Common	Minor to Moderate
Accidental damage	Medium to High	Temporary to Long-term	Local to Regional	Common	Minor to Moderate
Fugitive dust or environmental contamination	Low to Medium	Long-term	Local to Extended	Common	Minor to Moderate

Table 3.10-11: Impact Levels of Alternative 2 by Impact Type and Project Component

Impact Type	Impact Level by Factor				
	Magnitude or Intensity	Duration	Geographic Extent	Context	Summary Impact Rating[1]
Changes in water availability	Low to High	Temporary to Permanent	Local to Regional	Common	Minor to Moderate

Notes:

* The summary impact rating accounts for impact reducing design features proposed by Donlin Gold and Standard Permit Conditions and BMPs that would be required. It does not account for additional mitigation measures the Corps is considering.

3.10.3.3 ALTERNATIVE 3A – REDUCED DIESEL BARGING: LNG-POWERED HAUL TRUCKS

Alternative 3A would replace diesel fuel with liquefied natural gas (LNG) to power the mine haul trucks.

3.10.3.3.1 MINE SITE – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

There would be no change in the location or operations of the mine site under Alternative 3A, therefore the impacts to vegetation would be the same as described under Alternative 2.

3.10.3.3.2 TRANSPORTATION FACILITIES – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

Alternative 3A differs from Alternative 2 in that it would involve 75 percent fewer ocean fuel barge trips and 67 percent fewer river fuel barge trips because of the decreased use of diesel fuel. There would also be proportionally fewer trucks hauling diesel on the Jungjuk road (about half as many during the operations phase), which would reduce the amount of fugitive dust that could affect vegetation. Construction areas would be the same as Alternative 2, and most impacts to vegetation would be the same.

Reducing the number of fuel barge trips reduces, but does not eliminate, the risk of adverse impacts to vegetation from invasive species potentially transported by barges. Invasion prevention and management practices would not change; design features, EDRR principles, BMPs, and the ISMP would remain the same as in Alternative 2. The change in the number of fuel barge trips would not affect the impacts from vegetation removal, removal of rare or sensitive plants, changes in water availability, or risk of accidental damage. The summary impacts of the transportation facilities on vegetation would remain moderate.

3.10.3.3.3 PIPELINE – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

There would be no change in the location or operations of the pipeline under Alternative 3A (except that an increased volume of natural gas would be shipped through the pipeline); therefore, the impacts to vegetation would be the same as described under Alternative 2.

3.10.3.3.4 SUMMARY CONCLUSION FOR ALTERNATIVE 3A

The overall direct and indirect effects of the project on vegetation would be essentially the same as described under Alternative 2. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Impacts associated with climate change would also be the same as those discussed for Alternative 2. Additional mitigation and monitoring measures are also described in Alternative 2. If these mitigation measures were adopted and required, the summary impact rating would be the same as Alternative 2, moderate.

3.10.3.4 ALTERNATIVE 3B – REDUCED DIESEL BARGING: DIESEL PIPELINE

Under Alternative 3B, an 18-inch diameter diesel pipeline would be constructed from Cook Inlet to the mine site, instead of a natural gas pipeline, to eliminate diesel barging on the Kuskokwim River. The proposed diesel pipeline would be located in the same corridor proposed for the natural gas pipeline under Alternative 2, with an additional segment between Tyonek and the start of the proposed corridor for the natural gas line. The diesel pipeline would extend 334 miles from Cook Inlet to the Donlin Mine. The diesel pipeline would require a 19-mile extension from the proposed terminus of the natural gas pipeline, south to Tyonek. This additional segment would cross the Beluga River.

This alternative would require either construction of a new dock facility in Tyonek or expansion of the existing Tyonek North Foreland Barge Facility. A new tanker berth system would be needed at Tyonek to accommodate the tide, ice, and seismic conditions and provide adequate depth for continuous 24-hour operation. A barge landing at Tyonek sufficient for most tidal stages would be required to support the construction and operation of the facilities. Tanks sufficient for storing one month's fuel consumption, approximately 10-million gallons, would be installed at each end of the proposed pipeline.

3.10.3.4.1 MINE SITE – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

There would be no change in the location of the mine site under Alternative 3B; however, there would be a change in operations. Diesel fuel would be used instead of natural gas. The difference in fuel is not expected to change the type or level of effects on vegetation at the mine site, so they would be the same as described for Alternative 2.

3.10.3.4.2 TRANSPORTATION FACILITIES – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

The transportation facilities would remain mostly the same as Alternative 2; however diesel barging on the Kuskokwim River would be eliminated after the construction period. Both river

and ocean cargo barges would still be necessary for cargo, but the fuel would go to Cook Inlet instead of Bethel. Total barge traffic on the Kuskokwim River would be substantially reduced (nearly halved). The reduction in barge traffic would reduce the level of barge-related impacts to vegetation along the river and road, including the risk of spills. The addition of a diesel fuel barge from either northwest marine terminals or Nikiski to Tyonek would impact vegetation in the vicinity of Tyonek through direct vegetation removal for a new dock and tanks, and by increasing the potential for introduction of new invasive species or spread of existing known invasive plant species in Tyonek. Invasion prevention and management practices would not change; design features, EDRR principles, BMPs, and the ISMP would remain the same as in Alternative 2. The summary impacts of the transportation facilities on vegetation would remain moderate.

3.10.3.4.3 PIPELINE – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

The location of the proposed pipeline would remain approximately the same as Alternative 2. The additional 19 miles of pipeline and clearing in the vicinity of the Tyonek dock would require an additional 250.7 acres of vegetation removal (Table 3.10-12). The potential for introduction of invasive species is slightly greater than in Alternative 2 because of the greater amount of vegetation removal and known occurrences of terrestrial invasive plant species in the vicinity of the Tyonek dock and along the 19-mile extension (see Figure 3.10-8). Invasion prevention and management practices would not change; design features, EDRR principles, BMPs, and the ISMP would remain the same as in Alternative 2. In addition, spill response requirements and pre-positioned equipment storage would require leaving some construction facilities, roads, helipads, and airstrips in a usable condition after construction, causing long-term rather than temporary duration. Spill risks and effects are discussed in Section 3.24, Spill Risk. The summary impacts of the pipeline on vegetation would remain moderate.

Table 3.10-12: Alternative 3B Diesel Pipeline Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation in Watershed*
Western Cook Inlet Watershed		
Forested – Deciduous/Mixed	150.0	0.136
Forested – Coniferous	21.3	0.039
Shrub	107.7	0.060
Herbaceous	31.4	0.019
Other Land Cover	33.2	0.112
Susitna River Watershed		
Forested - Deciduous/Mixed	981.9	0.081
Forested - Coniferous	177.8	0.010
Shrub	773.9	0.022
Herbaceous	69.8	0.006
Other Land Cover	5.2	0.0004
Upper Kuskokwim Watershed		
Forested; Deciduous/Mixed	555.8	0.043
Forested; Coniferous	1,268.6	0.017
Shrub	1,083.4	0.043
Herbaceous	115.1	0.013
Other Land Cover	44.1	0.003
Lower Kuskokwim Watershed		
Forested; Deciduous/Mixed	93.2	0.041
Forested; Coniferous	105.8	0.008
Shrub	565.1	0.037
Herbaceous	24.6	0.097
Other Land Cover	6.6	0.007
TOTAL:	6,214.5	

Notes:

* Watershed data from Boggs et al 2014b. Vegetation Map and Classification: Northern, Western, and Interior Alaska, 2014 Update.

Source: 3PPI 2014b.

3.10.3.4.4 SUMMARY CONCLUSION FOR ALTERNATIVE 3B

The overall direct and indirect effects of the project on vegetation would be essentially the same as described under Alternative 2 with the addition of the effects of the additional pipeline

length and new dock and storage facilities. Impacts associated with climate change would also be the same as those discussed for Alternative 2. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Additional mitigation and monitoring measures are also described in Alternative 2. If these mitigation measures were adopted and required, the summary impact would be the same as Alternative 2, moderate.

3.10.3.5 ALTERNATIVE 4 – BIRCH TREE CROSSING (BTC) PORT

This alternative would move the port facility downstream to BTC, 69 miles downriver from Angyaruaq (Jungjuk) Port. This would reduce barge distances for freight and diesel, but would increase the access road distance from 30 miles for the Angyaruaq (Jungjuk) Road in Alternative 2 to 76 miles for the BTC Road. An ice road up the Crooked Creek valley would be required to start construction of the road and facilities needed, which would require additional clearing of tall woody vegetation. There would be no other substantive changes from Alternative 2.

3.10.3.5.1 MINE SITE – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

There would be no change in the location or operations of the mine site under Alternative 4; therefore, the summary impacts to vegetation would be the same as described under Alternative 2, moderate.

3.10.3.5.2 TRANSPORTATION FACILITIES – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

Alternative 4 would include a port at BTC with the same facilities proposed for Alternative 2. While there are fewer river miles between Bethel and BTC, this would be offset by a longer road to the mine site. Because the haul distance and round-trip time are longer, roughly twice as many trucks would be required to deliver materials during the barging season. The shorter barge distance would shorten the round trip barge travel time. Overall, there would be the same number of barge trips under Alternative 4 as in Alternative 2.

The change in the location of the port would eliminate project-related barge traffic on more than 60 miles of the Kuskokwim River between the BTC Port site and the Angyaruaq (Jungjuk) Port site. The longer port road and additional ice road would cause an additional 732.2 acres of vegetation removal, with possible conversion from forest and shrub vegetation community types to low vegetation types along the ice road. Table 3.10-13 lists acres of vegetation by type that would be removed. Rare or sensitive plant removal would not change from Alternative 2. Additional vegetation removal may slightly increase invasion risk. The elimination of barging upstream of BTC would reduce the risk of invasive species introduction or spread in that section of the river. Invasion prevention and management practices would not change; design features, EDRR principles, BMPs, and the ISMP would remain the same as in Alternative 2. There may be slightly increased fugitive dust, increased risk of environmental contamination, and changes in water availability. Impacts associated with climate change would be the same as those discussed for Alternative 2.

Table 3.10-13: Alternative 4 Transportation Facilities Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation in Watershed*
Lower Yukon Watershed		
Forested – Deciduous/Mixed	21.0	0.001
Forested - Coniferous	294.0	0.004
Shrub	240.0	0.003
Herbaceous	3.4	0.00009
Other Land Cover	0.2	0.00001
Lower Kuskokwim Watershed		
Forested – Deciduous/Mixed	105.0	0.046
Forested - Coniferous	324.6	0.023
Shrub	494.3	0.032
Herbaceous	111.1	0.438
Other Land Cover	11.5	0.012
TOTAL:	1,604.5	

Notes:

* Watershed data from Boggs et al 2014b. Vegetation Map and Classification: Northern, Western, and Interior Alaska, 2014 Update.

Source: 3PPI 2014b.

The summary impacts on vegetation would be essentially the same as described under Alternative 2, moderate, but with more acres of direct vegetation removal.

3.10.3.5.3 PIPELINE – CONSTRUCTION; OPERATIONS AND MAINTENANCE; AND CLOSURE, RECLAMATION, AND MONITORING

There would be no change in the location or operations of the proposed pipeline under Alternative 4; therefore, the summary impacts to vegetation would be the same as described under Alternative 2, moderate.

3.10.3.5.4 SUMMARY CONCLUSION FOR ALTERNATIVE 4

The overall direct and indirect effects of the project on vegetation would be essentially the same as described under Alternative 2. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Additional mitigation and monitoring measures are also described in Alternative 2. If these mitigation measures were adopted and required, the summary impacts would be the same as Alternative 2, moderate.

3.10.3.6 ALTERNATIVE 5A – DRY STACK TAILINGS

Alternative 5A would be an alternate tailings disposal method at the mine site. The primary objective of the dry stack process is to reduce the potential of tailings water leaving the tailings storage facility to reduce potential impact to the environment and overall footprint of the project. For Alternative 5A, the difference for direct vegetation impacts would be limited to the footprint of the TSF (see Figure 3.10-3).Table 3.10-14 lists acres of vegetation by type that would be removed. The footprint of the mine site would be increased by 446.8 acres compared to Alternative 2 (Table 3.10-15). The dry stack method of tailings disposal would also increase the amount of dust produced, which could lead to greater fugitive dust-related impacts on vegetation. The summary impacts of the pipeline on vegetation would remain moderate.

The other two project components (the transportation facilities and pipeline) would remain the same as described under Alternative 2, and would cause the same level of impact to vegetation. Invasion prevention and management practices would not change; design features, EDRR principles, BMPs, and the ISMP would remain the same as in Alternative 2.

Table 3.10-14: Alternative 5A Mine Site Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation Within Watershed*
Lower Kuskokwim Watershed		
Forested – Deciduous/Mixed	852.2	0.372
Forested – Coniferous	6,627.0	0.478
Shrub	1,533.6	0.100
Herbaceous	182.7	0.720
Other Land Cover	205.8	0.212
TOTAL:	9,401.4	

Notes:

* Watershed data from Boggs et al. 2014b. Vegetation Map and Classification: Northern, Western and Interior Alaska, 2014 Update.

Source: 3PPI 2014b.

Table 3.10-15: Alternative 5A Mine Site Vegetation Direct Impacts Compared to Alternative 2

Vegetation Type	Alternative 5A (acres)	Alternative 2 (acres)	Difference (acres)
Forested-Deciduous/Mixed	852.2	841.3	+11.1
Forested - Coniferous	6,627.0	6,259.2	+367.8
Shrub	1,533.7	1,498.5	+35.1
Herbaceous	182.8	181.2	+1.6
Other Land Cover	205.8	174.4	+31.4
TOTAL:	9,401.4	8.954.6	+446.8

Source: 3PPI 2014b.

3.10.3.6.1 SUMMARY CONCLUSION FOR ALTERNATIVE 5A

The overall direct and indirect effects of the project on vegetation would be essentially the same as described under Alternative 2. Impacts associated with climate change would be the same as those discussed for Alternative 2. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Additional mitigation and monitoring measures are also described in Alternative 2. If these mitigation measures were adopted and required, the summary impact rating would be the same as Alternative 2, moderate.

3.10.3.7 ALTERNATIVE 6A – MODIFIED NATURAL GAS PIPELINE ALIGNMENT: DALZELL GORGE ROUTE

Alternative 6A consists of an alternative pipeline route segment. The only project component that would differ from Alternative 2 is the proposed pipeline, which would be 314.2 total miles in length. Under Alternative 6A the proposed pipeline alignment would be located to the west of the Alternative 2 pipeline alignment between MP 106.5 and MP 152.7, and would traverse Dalzell Gorge. The different route would change the amount and types of vegetation that would be disturbed.

Table 3.10-16 lists acres of vegetation by type that would be removed, and Table 3.10- shows the difference in acres of vegetation impacted by the proposed pipeline route under Alternative 6A compared to Alternative 2. Under Alternative 6A, slightly more of each vegetation type would be impacted. The difference in the proposed pipeline route location would change only the amount and type of vegetation directly affected. Invasion prevention and management practices would not change; design features, EDRR principles, BMPs, and the ISMP would remain the same as in Alternative 2. The summary impacts of the pipeline on vegetation would be moderate.

The other two project components (the mine site and transportation facilities) would remain the same as described under Alternative 2 and would cause the same level of impact to vegetation.

Table 3.10-16: Alternative 6A Pipeline Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation Within Watershed*
Western Cook Inlet Watershed		
Forested; Deciduous/Mixed	80.0	0.087
Forested; Coniferous	10.3	0.016
Shrub	10.5	0.005
Herbaceous	0.9	0.001
Other Land Cover	10.9	0.048
Susitna River Watershed		
Forested; Deciduous/Mixed	959.2	0.079
Forested; Coniferous	181.9	0.011
Shrub	867.5	0.024

Table 3.10-16: Alternative 6A Pipeline Vegetation Direct Impacts

Vegetation Type	Impacted Area (acres)	Percentage of Vegetation Within Watershed*
Herbaceous	87.1	0.008
Other Land Cover	7.0	0.001
Upper Kuskokwim Watershed		
Forested; Deciduous/Mixed	278.0	0.021
Forested; Coniferous	1,266.4	0.017
Shrub	1,040.0	0.042
Herbaceous	103.7	0.012
Other Land Cover	54.7	0.003
Lower Kuskokwim Watershed		
Forested; Deciduous/Mixed	90.5	0.040
Forested; Coniferous	91.8	0.007
Shrub	706.6	0.046
Herbaceous	23.7	0.093
Other Land Cover	5.7	0.006
TOTAL:	5,876.5	

Notes:

* Watershed data from Boggs et al 2014b. Vegetation Map and Classification: Northern, Western and Interior Alaska, 2014 Update.

Source: 3PPI 2014b.

Table 3.10-17: Alternative 6A Pipeline Vegetation Direct Impacts Compared to Alternative 2

Vegetation Type	Alternative 6A (acres)	Alternative 2 (acres)	Difference (acres)
Forested-Deciduous/Mixed	1,407.8	1,695.6	-287.7
Forested – Coniferous	1,550.5	1,568.4	-17.9
Shrub	2,624.6	2,423.2	+201.4
Herbaceous	215.3	205.6	+9.7
Other Land Cover	78.3	71.1	+7.2
TOTAL:	5,876.5	5,963.8	-87.3

Source: 3PPI 2014b.

3.10.3.7.1 SUMMARY CONCLUSION FOR ALTERNATIVE 6A

The overall direct and indirect effects of the project on vegetation would be essentially the same as described under Alternative 2. Impacts associated with climate change would be the same as those discussed for Alternative 2. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Additional mitigation and monitoring measures are also described in Alternative 2. If these mitigation measures were adopted and required, the summary impact rating would be the same as Alternative 2, moderate.

3.10.3.8 IMPACT COMPARISON – ALL ALTERNATIVES

Although there are differences among alternatives in the project components that would affect vegetation, e.g., longer or shorter port road or pipeline, more or less barge trips, and smaller or larger mine footprint, the summary impact level is moderate for all the alternatives. While the effects of one component may be reduced under one alternative, impacts from the other components remain. For example, while reducing the number of barge trips would reduce the risk for invasive species, impacts from the mine site and pipeline would remain, therefore the summary impact level of the alternative is unchanged. Because there are so many impact-causing components to the project, at least one of them would cause moderate impacts under each of the action alternatives. That does not mean that all the alternatives would affect vegetation equally, but the percentage difference is small for vegetation impacts. A comparison of the impacts by alternative is presented in Table 3.10-18.

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Table 3.10-18: Comparison of Impacts by Alternative*

Impact-Causing Project Component	Alternative 2 – Proposed Action	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings	Alternative 6A –Dalzell Gorge Route
Total acres of vegetation removal impact	15,790.7 acres of vegetation removal.	Same as Alternative 2.	16,041.4 acres of vegetation removal.	16,522.9 acres of vegetation removal.	16,237.5 acres of vegetation removal.	15,703.4 acres of vegetation removal.
Rare or sensitive plant impact	An unconfirmed population of fowl mannagrass in the mine site area would be removed. Two populations of rare plants are located within the Project Area in the vicinity of the pipeline, but would not be affected by construction.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site	8,954.6 acres of vegetation removal.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Increased amount of fugitive dust. 9,401.4 acres of vegetation removal (additional 446.8 acres).	Same as Alternative 2.

Table 3.10-18: Comparison of Impacts by Alternative*

Impact-Causing Project Component	Alternative 2 – Proposed Action	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings	Alternative 6A –Dalzell Gorge Route
Transportation Facilities	Angyaruaq (Jungjuk) Port site construction. 30-mile mine access road construction. 872.4 acres of vegetation removal.	Fewer diesel fuel trucks and trips.	Fewer LNG fuel trucks and trips. Tyonek port sites and pipeline extension construction.	BTC Port site construction. 76-mile mine access road. Shorter barge route along Kuskokwim River. 1,604.5 acres of vegetation removal (additional 732.2 acres).	Same as Alternative 2.	Same as Alternative 2.
Pipeline	315-mile long natural gas pipeline. 5,963.8 acres of vegetation removal.	Same as Alternative 2.	334-mile long diesel pipeline. 6,214.5 acres of vegetation removal (additional 250.7 acres).	Same as Alternative 2.	Same as Alternative 2.	314.2-mile long natural gas pipeline. 5,876.5 acres of vegetation removal (87.5 fewer acres).
Barge trips (river)	122 trips/year.	83 trips/year, fewer trips reduces barge-related invasion risk.	64 trips/year, fewest trips means least barge-related invasion risk.	122 trips/year, but eliminates barge-related invasion risk upstream of BTC.	Same as Alternative 2.	Same as Alternative 2.

Table 3.10-18: Comparison of Impacts by Alternative*

Impact-Causing Project Component	Alternative 2 – Proposed Action	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings	Alternative 6A –Dalzell Gorge Route
Barge trips (ocean)	20 trips /year during construction and 26 trips/year during operations from Dutch Harbor to Bethel.	20 trips/year during construction and 17 trips/year during operations from Dutch Harbor to Bethel. Fewer annual trips reduces barge-related invasion risk.	12 trips/year between Marine Terminals in Pacific Northwest or from Tesoro Refinery in Nikiski to Tyonek. Increases risk of invasive species spread from Tyonek	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Summary Impact Level	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**

Notes:

* The No Action Alternative would have no new impacts.

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